AMERICAN DYESTUFF REPORTER

"Circulated Everywhere Dyestuffs Are Used"

Published by Howes Publishing Company, 90 William Street, New York

Devoted to the practical application of dyestuffs in all industries; especially to textile chemistry—the science and practice of scouring, bleaching, dyeing and finishing.

VOL. XVIII NEW YORK, JANUARY 7, 1929 No. 1

Suggested Method of Choosing Dyeing and Bleaching Machinery in Your Plant

A Simple and Practical System of Checking the Equipment Selected for All Its Essential Features and for a Few Minor Points Sometimes Overlooked

By HENRY BARKER BURKE

MANAGERS, plant engineers and, frequently, chemists in advisory or supervisory capacity are called upon to choose equipment for the dyehouse or the bleachery. Demands of expansion may suddenly throw upon the inexperienced the burden of choosing the proper and efficient machine for the work. Or managers may suddenly be confronted with the fact, through competitive pressure, that their equipments are obsolescent. New equipment is required. The following brief may prove to be helpful to those responsible for recommendations to purchase and probably of more value to those in executive capacity, where it will prompt intelligent questioning of reported surveys or recommendations.

FIRST—Assemble all makers' catalogues and descriptive matter.

SECOND—Decide which make or makes seem likely to meet your requirements for—

1. Skein woolens or worsteds.
2. Skein cottons, tapes or braids.
3. Package dyed yarns.
4. Raw stock cotton.
5. Raw stock wools, shoddy or rags.
6. Package dyed raw stocks.
7. Top, roving or other intermediate yarn processes.
8. Silk skein or raw stock.
9. Rayon.
10. Piece dyeing—cotton, woolen or worsted, union material, cotton rayon mixtures.
11. Warp dyeing—long or short warps, beams or spools.
12. Hosiery dyeing—cotton, rayon, silk, woolen or mixtures.
13. Special products.

THIRD—Does the tentative selection permit of universal or specific use—i. e., can the equipment be employed to dye or bleach more than one kind of work? Example: Could the machine handle skein cottons, tapes and braids without changes? Or, could packages be followed by raw stock, and could raw cotton be handled in the same equipment as raw wool?

These changes being easily effected physically, are they productive of satisfactory practical results?

FOURTH—Make an exhaustive comparative examination of—

I—Adaptability:

1. Consider whether all classes of dyeing may be carried on in the machine, as direct colors, basic colors, sulphur colors, acid colors, chrome colors top and bottom, aftertreated colors, etc. Bleaching.
2. Consider whether all classes of material can be treated. Can any length of skein be treated? Can different weights and sizes of packages be treated?
3. Consider the character of the work. Is the woolen yarn left "lofty," or is it felted and matted? Can skeins be easily rewound, or are they tangled? Can contraction occur without injury to the yarn? Can raw stocks be uniformly penetrated? And do they nub up, or mat and felt?

II—Uniformity of Colorings:

1. Can all colors be applied with level results?
2. Is the circulation positive and gentle through the batch, or is it under heavy pressure, or is the material dragged through the dye solution?
3. Can the rinsing be quickly and effectively accomplished?
4. Is the dye consumption economical?

III—Steam Consumption:

1. Weight for weight of material, consider the volume of the dye bath or bleach.

2. Is the bath, once heated, subjected to cooling, or is the stock totally submerged and the machine covered so as to retain its heat and prevent steamy working conditions?

IV—Labor:

1. How many machines can one man operate? What is the number of men necessary to a certain definite poundage which you may now be securing? This will give a definite comparison in your own terms.
2. What is the length of time required to load and to unload the machine? Does this vary with the load, or is it the same for all loads?
3. How many times must the material be handled before dyeing or bleaching is completed? Can serial work be done in the machine without rehandling, as dyeing, rinsing, aftertreating, etc.?

V—Production:

1. Number of batches or poundage completed per day per machine.

VI—Mechanical Features:

1. Simplicity, freedom from complicated parts, freedom from metallic parts in the dye section or parts open to the corrosive action of the various baths.
2. Horse-power; life of machine; upkeep.
3. Dispatch in handling; floor space required.
4. Adaptability to a system.
5. Electrical controls and power.
6. Necessary accessories and space required for same.

VII—Price for Comparison with:

1. Competitors' prices on a money value as gauged from evaluation of similar equipments and their productiveness.
2. Cost of installation.

Equipment selected by such careful scrutiny and such searching comparisons as are here suggested, rather than by chance familiarity and sales pressure, will be recognized as the most satisfactory basis for adoption. It is also suggested that the purchaser see in complete operation the equipment decided upon prior to actual purchase, and in this respect it is better to visit at least two, and if possible three, representative plants so equipped. If these plants do work comparable to your own, you have a positive idea of what you can accomplish with similar equipment in your own plant.

JAPANESE DYE TRADE HIT

According to current reports from Tokyo, the importations of dyes into Japan from Germany since the recent abolition of limitations by the Japanese Government have been heavy. This increase has been felt by dye producers, particularly the Nippon Senryo Kabushiki Kaisha, Osaka (Japan Dyestuff Manufacturing Company, Ltd.), the largest producing institution of its kind in the country under special government protection.

New Device Favored for Identifying Colors*

Spectrophotometer Said to Give More Accurate Results

By W. C. Holmes

Color and Farm Waste Division, Department of Agriculture

MUCH of the spectrophotometric investigation carried out at Color and Farm Waste Division is undertaken at the request of, or in the interests of outside agencies and is concerned with specific technical applications. An enumeration of recent instances will illustrate, in some measure, the wide utility of spectrophotometric methods.

In the collaboration which the Division affords the Commission on Standardization of Biological Stains the spectrophotometer plays an important part. Stains are most conveniently identified and analyzed by the spectrophotometer and scientific specifications for stains which will define both the identity and content of the component dyes are expressed most adequately in terms of spectrophotometric constants.

In the examination of stains it is often desirable to differentiate between dyes of closely related structure. With basic fuchsin, for example, which is employed in a large number of diverse staining applications, it is advisable to identify the four homologs which may be encountered and determine their approximate relative proportions when more than one is present.. The determination of a suitable spectrophotometric ratio affords an extremely convenient means for disclosing the essential nature of the sample. Similar ratios are employed in the examination of other stains.

Mislabeling Is Found

The investigation of prewar Grubler stains has revealed numerous instances of mislabeling, and it has been one of the principal aims of the Commission to assure the purchaser of American stains of their essential character in as definite degree as may be possible. Mislabeling of stains or dyes does not always arise from deliberate intention on the part of the dealer. In some instances the dealer has been misinformed by the dye manufacturer. Even the actual manufacturer may err unintentionally.

A reliable American dye manufacturer recently undertook the preparation of Thionin Blue O and obtained Methylene Blue; a second concern obtained the color acid of eosine instead of theyl eosine, as was intended, and asymmetrical dimethyl thionin instead of Toluidine Blue O.

*Paper delivered before the Dye Division, American Chemical Society, at the meeting at Swampscott, Mass., October 25.

Measurements recently carried out on a series of Indophenols for the Hygienic Laboratory indicate that an excellent scheme for the identification and analysis of phenols may be based upon their conversion to indophenols and the spectrophotometric examination of the resulting solutions. Analogous schemes had been advanced, previously, by Gsell and by Formanek and Knop, who condensed phenols with phthalic anhydride to obtain phthalein dyes, and by Palkin and Wales of the Bureau of Chemistry, who coupled their phenols with diazo-nitrobenzene to obtain azo dyes.

Color Substance Identified

The identification and estimation of colorless substances through their conversion into coloring matters is applicable, of course, to a great variety of substances other than phenols. Many important color reactions are employed, for example, by biochemists. Two such reactions for the estimation, respectively of tryptophane and of ergothioneine were recently studied with the spectrophotometer in co-operation with the Bureau of Dairy Industry. A series of dye formulae for monochromatic light filters of visible light were developed to further the photochemical investigations of the same Bureau.

Two recent investigations have been concerned with inorganic substances. A method for determining aluminum by converting it into the aluminum lake of tricarboxyaurin was investigated for the Mellon Institute, and a method for the determination of boron by converting it to a colored boron compound with curcumin was studied for the Bureau of Chemistry and Soils. In neither of these instances were the results entirely satisfactory, although it appears probable that further investigation of the many variables involved might lead to improvement. A reliable qualitative test was developed, however, which is adequate for the detection of one part of boron in 25,000,000 parts of solution.

Gases Are Analyzed

A further venture into the field of inorganic chemistry was made in the interests of the Fertilizer Division, for whom promising preliminary results were obtained in the spectrophotometric analysis of the gases evolved in the reactions of nitric and hydrochloric acids. Since the relative absorption of nitrosyl chloride and of nitrogen dioxide at 570 and 600 mm. is widely different, the determination of that ratio affords an excellent criterion of the relative proportions of the gases in mixtures.

A series of studies of spectrophotometric determinations of hydrogen ion concentrations and of the apparent dissociation constants of indicators have been made in collaboration with Soil Fertility Investigations. Spectrophotometric methods with indicators are exceptionally convenient and accurate, and seem certain to find wide application.

Cell Behavior Studied

The Color and Farm Waste Division has co-operated with the Rockefeller Institute in connection with researches into the nature of protoplasm and the mechanism of cell behavior. The penetration of dyes into living cells is being studied. The results obtained with Methylene Blue may be cited to illustrate the utility of spectrophotometric analysis in such instances.

The apparent penetration of the dye, as indicated by colorimetric examinations of the cell solutions in capillary tubes, was greatly in excess of theoretical expectations based upon the extreme basicity of the dye. The spectrophotometer, however, at once revealed the fact that only a minor proportion of the dye which entered the cells was actually Methylene Blue. The principal component present was trimethyl thionin, a lower homolog which is always present in Methylene Blue as an impurity. Its ready penetration into cells is entirely consistent with its inferior basicity under the accepted hypotheses respecting cellular penetration.

In view of the theoretical importance of these conclusions, and the fact that their validity was called in question, a spectrophotometric method was developed by which it is possible to determine with satisfactory accuracy the relative proportions in mixtures of the two dyes in question. This method was utilized subsequently in investigating the conditions under which trimethyl thionin may be formed from Methylene Blue by hydrolysis.

Within our experience the spectrophotometer has proved more convenient and accurate than the colorimeter even in instances in which the latter instrument is reasonably reliable. Its principal advantage over the colorimeter, however, arises from the analysis it affords of the components of colors. It proves reliable and illuminating in many instances in which the colorimeter is unreliable and misleading.

NEW DIRECTORY OF DYE FIRMS ISSUED

A very handy and complete directory of American manufacturers of dyes and other synthetic organic chemicals has just been issued by the Synthetic Organic Chemical Manufacturers' Association. The manufacturers are classified alphabetically and their products are listed according to the data given in the recently issued "Census of Dyes and Other Synthetic Organic Chemicals" for 1927, published by the United States Tariff Commission. Under each manufacturer the various products are classified by kind and Colour Index numbers are given for many of the dyes.

E. H. KILLHEFFER MADE PRESIDENT OF NEWPORT

Dr. E. H. Killheffer has been promoted to the presidency of the Newport Chemical Works, Passaic, N. J., after serving as vice-president of the corporation for the past ten years. He succeeds A. A. Schlessinger, who recently resigned the office.

Dr. Killheffer has been an active and outstanding figure not only in the American dyestuff industry but among those groups of technical men represent-

ing both textile and dyestuff interests which have been so actively engaged in furthering the cause of technical research on dyes and textile chemistry. He is a vice-president of the Synthetic Organic Chemical Manufacturers' Association and chairman of the Dyes Section, as well as chairman of its general Tariff Committee. After serving for several years as vice-president of the American Association of Textile Chemists and Colorists he was elected president in 1927 and re-elected at the Eighth Annual Meeting of this association held in Providence in December.

Dr. Killheffer was born in 1884 at Millerville, Pa., and obtain his early education in the public schools of Philadelphia. He developed an interest in chemistry as a boy and obtained his first technical training at the Philadelphia Textile School from which he was graduated. He was later employed in the New York laboratories of Kalle & Co. as chief chemist and was sent to their plant at Biebrich-on-Rhine, Germany, where he acquired an intimate knowledge of dyestuff manufacturing processes.

Soon after the outbreak of the World War, Dr. Killheffer was appointed purchasing agent for a concern known as the Orient Trading Company, formed by interests connected with the silk industry of Paterson for the purpose of purchasing from China and Japan stocks of German dyestuffs known to be available in those two countries. The colors that Dr. Killheffer was able to secure in the Far East during this venture were badly needed at the time and were of great assistance to American dyestuff consuming industries. Upon his return to America he started in the dye manufacturing business at Passaic, N. J., under the name of the American Color Manufacturing Company. After a very successful period of production this concern made an agreement at the conclusion of the war whereby it was absorbed by the Newport Chemical Works, Inc., and Dr. Killheffer was appointed vice-president of the latter firm.

It is a rather interesting fact that, among the large manufacturers in the American dyestuff industry, Dr. Killheffer is the only executive representing capital other than his own who has survived the various mergers, failures and other vicissitudes of the past ten years' development within the industry.

SWISS CHEMICAL FACTORY INCREASES CAPITAL

The Fabrique de Produits Chimiques, formerly Sandoz & Co., at Basle, has recently decided to increase its capital stock from the present figure of 7,500,000 Swiss francs to 10,000,000 Swiss francs. (1 Swiss franc equals $0.1924 United States currency.) The new shares will have a par value of 100 francs each. Present stockholders are to enjoy a certain amount of preference in the subscription, three shares of the old stock giving the right to one share of the new. The proceeds of this issue of 2,500,000 francs will be used to swell the company's reserve fund, which will thus be increased to 5,000,000 francs, according to the Chemical Division of the Commerce Department.

NEW WOOL AND SILK COLORS

Two interesting new dyestuffs have been developed and placed on the market by the Dyestuffs Department of E. I. du Pont de Nemours & Co. One of these is really a replacement, known as Du Pont Violamine RR, a very red acid violet. The new product, it is explained in the announcement, is much brighter than the former offering and dyes better from a neutral bath, so that it is a superior silk color than the old brand.

This new Violamine RR is used largely for materials that require hard wear, such as carpet and sweater yarns, hat felts, etc., and good fastness properties, especially to light, washing and fulling, is claimed for it. The fastness to fulling is improved by after-treatment with chrome and it can be used for shading chrome colors. It is further described as being very suitable for both pure and weighted silk.

The second product is an acid blue marketed under the name of Pontacyl Fast Blue GR Conc., which is similar to the 5R type of the same series but considerably greener in shade. On wool, it is claimed, this product shows excellent fastness to acid and water spotting, carbonizing, rubbing and ironing and good fastness to light, alkalies, perspiration and water. It is said to be very soluble and to exhaust well and can therefore be used for machine dyeing.

Proceedings of the American Association of Textile Chemists and Colorists

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EIGHTH ANNUAL MEETING
SATURDAY MORNING SESSION*
December 8, 1928

The meeting convened in the Biltmore Hotel, Providence, at 9:50 o'clock, Dr. E. H. Killheffer, President of the Association, presiding.

President Killheffer—Gentlemen, the first thing we will do this morning is appoint some tellers. I will appoint Mr. Durfee and Mr. Low. They will count the votes cast in the election of officers and be ready to make a report at the business session.

We have made one or two changes in our program. As you know, one of the papers that were to have been presented last night was put over until 9:45 this morning, and the paper that was to have been presented at 9:45 was postponed until 10:45; the 10:45 paper is moved forward to 2:30 this afternoon. Outside of that, everything stays just as is. (Laughter.)

It is my pleasure to introduce to you, gentlemen, A. R. Thompson, of the Rohm & Haas Company, who will present a paper entitled, "A New Method for Bleaching and Mercerizing Cotton Piece Goods Containing Vat, Naphthol and Sulphur Colors by the Use of Kieropon." Mr. Thompson! (Applause.)

Mr. Thompson—Gentlemen, the title of this paper indicates perhaps that I am going to show how to bleach sulphur colors with a product known by trade name as "Kieropon." That is a little bit misleading, because this particular product has no bleaching properties in itself. It serves only to protect the colors that are used in the production of colored fabrics, either striped or solid colors, against bleeding, marking or changing their shade when treated with alkalies of varying strengths.

Kieropon—New Method for Bleaching and Mercerizing Cotton Goods, Containing Vat, Naphthol and Sulphur Colors

By A. R. THOMPSON
Rohm & Haas Company

THE first paper to be presented on this subject was read at the annual meeting of the Association held in New York City, December 3 and 4, 1927, and was published in the AMERICAN DYESTUFF REPORTER of December 26, 1927.

*The report of the Open Forum held December 7, 1928, at the Biltmore Hotel, Providence, as well as the technical papers delivered and discussed, also a report of the Eighth Annual Dinner held at the Biltmore Hotel Saturday evening, December 8, was published in the Proceedings in the December 24 issue.

The principle governing the application and results obtained by bleaching colored stripe material by this process remains practically the same as described in that first article, but there are several important additional uses for Kieropon which have been discovered recently. The purpose of this article is to describe the new uses for Kieropon and point out certain interesting facts concerning the properties of this product.

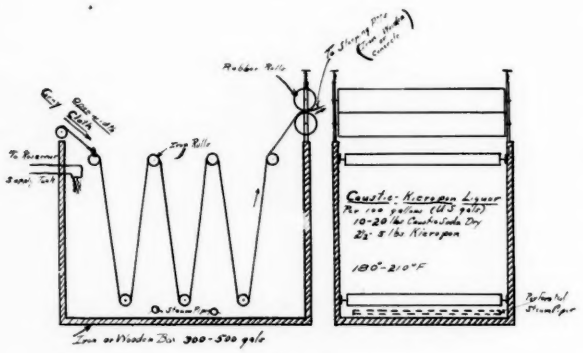


FIG. 1
Caustic-Kieropon Open Width Saturating Device

I—BLEACHING VAT DYED MATERIAL (STRIPES AND SOLID COLORS)

A—Caustic Soda Boil and Chlorine Bleach

The regular caustic soda boil followed by the chlorine bleach is still the most economical method for bleaching white goods, and with the use of Kieropon to protect the colors in the caustic soda treatment it is now the cheapest and safest method for bleaching solid color or colored stripe material.

Continuous Boiling-Out Process.—The method of passing the goods open width through the caustic soda-Kieropon solution at a temperature ranging from 180 to 212° F. and then squeezing the excess liquor from the material and allowing them to steep for six to fourteen hours in a wooden box, concrete pit or iron kier is still the most popular and economical method. This particular manner of handling the colored stripe goods has been in successful use in a large number of bleacheries for about two years. The quench box of the singer or an open width soaping machine, such as Fig. 1, is generally used in this connection for boiling out shirtings, broadcloths, table damasks, colored sheets, huck towels, etc.

It is quite surprising how thoroughly even very low-grade, tightly twisted and closely woven cotton material can be bottomed for the chlorine bleach in this way.

Perhaps you can see from here the type of machine that is used in saturating the goods with the caustic-Kieropon liquor, the goods passing in the open width under and over these rolls through this solution of boiling caustic soda and Kieropon and soluble oil, through a pair of squeeze rolls on into a pit or a kier, or a box, where the goods will steep hot overnight or for several hours, depending on the conveniences that the bleachery has for picking the goods up.

It is quite surprising how thoroughly even very low-grade material can be bottomed for the chlorine bleach by this process. In the past most folks have thought that it was necessary to give white goods and colored goods a severe kier boiling in order to properly bottom them for the chlorine bleach; but this is not absolutely true, gentlemen, even though the practice for the last fifty years seems to indicate that it is true, because we have made tests on the absorption of the cloth by both methods and you can hardly tell the difference; the white obtained by either method is comparable with the white obtained by the other method, and you do get a fuller weight. There is less loss in weight by this process than there is when you circulate the caustic soda liquors through the goods. That loss in the circulation is probably due to mechanical losses caused by the liquor running through the goods and washing the excess weight off.

After the goods have steeped in the hot caustic-Kieropon liquor for the proper time to thoroughly soften and remove the motes present, the goods are washed twice (a hot and then a cold wash, preferably), then chemicked and finished in the usual manner for handling white goods.

The Kieropon protects the vat and naphthol colors from bleeding while the colored stripe material is in contact with the caustic soda solution, and, of course, these colors are fast to the chlorine bleach and subsequent operations. It is possible to use Naphthol Reds (AS-SW with KB base and AS with TR base) to replace Turkey Red when using the Kieropon-chlorine bleach.

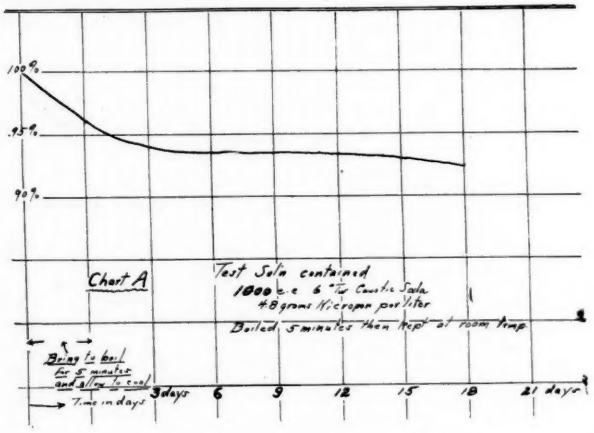


Chart A
Use of Kieropon in Standing Bath

You find that the naphthol colors which I have just mentioned are not fast to the peroxide bleach, and several of the bleacheries in the South have come up against the naphthol colors, which they thought were Turkey Red, and they put them in the kier with their peroxide and the colors faded. Then, when they tried them with this other process the colors held intact, and it offered a cheaper source of red yarn that they had not been able to get before.

The caustic-Kieropon liquor which is left over from one run can be saved in a reservoir tank and used over again the next day, or several days after, by building it back to the original strength with caustic soda and Kieropon. Great economies are made by reusing these liquors, and the main loss is due to what liquor is carried off by the cloth as it passes through the boiling solution and squeeze rolls.

I have some samples in here. As I discuss them, perhaps you would like to look at them. Mr. Dorsett will pass those samples around and show the different fabrics that have been bleached by this process in a commercial way. They represent only a small number, and I will explain them as I go along.

The following formula will illustrate the various steps in this process on several types of fabrics—i. e., handkerchiefs, shirtings and rayon stripe material:

Formula No. 1

1. Singe and pass goods in open width through caustic-Kieropon liquor in quench box containing 15 pounds caustic soda (dry), 4 pounds Kieropon and 4 pounds soluble oil per 100 U. S. gallons. Temperature 180 to 212° F. Speed 150 to 220 yards per minute.
2. Steep hot in a wooden box, concrete pit or iron kier for six to twelve hours.
3. Wash twice (hot and cold preferably).
4. Chemic 2° Tw. soda chemic (4 grams available chlorine per liter), 80 to 90° F. Steep four hours; wash and rechemic if necessary.
5. Wash.
6. Antichlor with sulphuric acid ½ to ¾° Tw., or sulphurous acid made from sulphur dioxide, or bisulphite of soda.
7. Wash; mangle and finish.

Formula No. 2

The following is a representative formula for bleaching heavier material—i. e., solid colored sheetings, colored stripe sheetings, colored bordered table damask, low-grade crash towels, cotton suiting, etc.:

1. Singe (if desired); pass dry goods in open width through a solution of caustic soda and Kieropon prepared as follows: 20 pounds caustic soda (dry), 5 pounds Kieropon and 4 pounds soluble oil per 100 U. S. gallons. Temperature 200 to 210° F.

It is necessary to use a little higher temperature in bleaching the lower grade fabrics, due to the fact that the higher temperature helps the caustic soda to penetrate more effectively.

(Nos. 2, 3, 4, 5, 6 and 7 same as in Formula No. 1.)

You will notice that the only practical difference in handling light-weight clean material and heavy, coarser material made from lower grade cotton or linen is in the amount of caustic soda and Kieropon used to bottom the goods for the bleach. The caustic-Kieropon treatment in both cases also removes the sizing material in addition to softening the motes, and gives the material an excellent preparation for mercerizing, if the goods call for this type of finish.

Kier Boiling Colored Goods.—There are a few cases where it is advantageous to put the goods in a kier and circulate the caustic-Kieropon solution for several hours. This method of handling the Kieropon process is useful for bleaching terry towels, etc., where little or no tension should ever be applied to the goods. This method can also be used satisfactorily on very heavy or low-grade material, or where other equipment in the bleachery is not convenient for handling the goods as described in Formulas No. 1 and No. 2.

The production is reduced by the kier boiling method and the cost for steam and power is a trifle higher than in methods No. 1 and No. 2. The kier should be equipped with a pump and outside heater attachment to assure positive circulation and prevent local overheating.

The following formulas have proven successful where kier boiling is necessary:

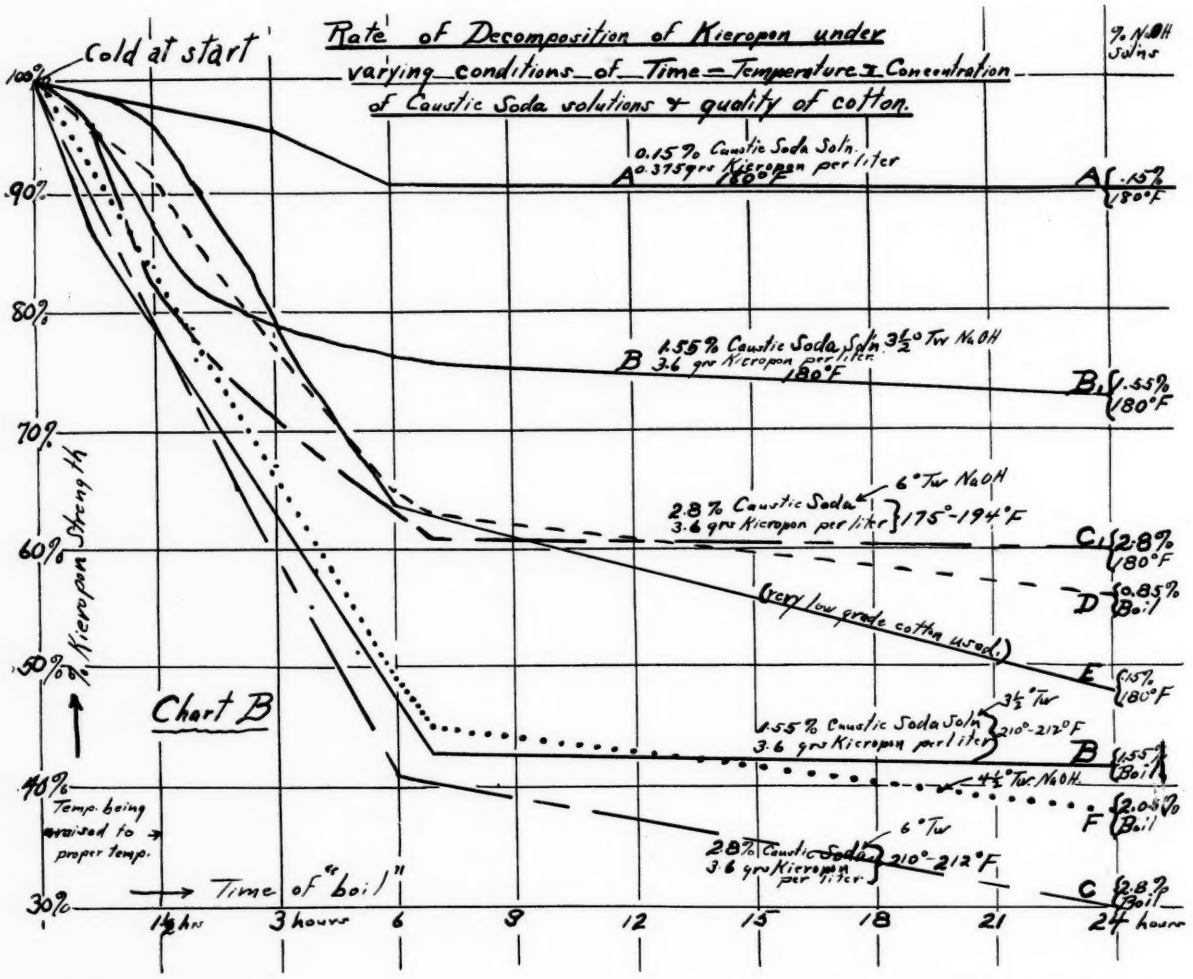
Formula No. 3

1. Caustic soda, 3%; Kieropon, ¾%; kier oil, 1%, based on the weight of the goods. Circulate eight to ten hours at 180° F.
2. Wash thoroughly.
3. Circulate soda chemic 1½ to 2½° Tw., 80 to 90° F., for one to three hours.
4. Wash thoroughly.
5. Sour ½° Tw. sulphuric acid.
6. Wash thoroughly.

I am giving you one more formula that might be useful on a lighter weight material:

Formula No. 4

1. Caustic soda, dry, 2%; soda ash, 2%; Kieropon, ½ to ¾%; kier oil, 1%, based on the weight of the goods. Circulate eight to ten hours at 180° F.



2. Wash thoroughly.
3. Chemic 1½ to 2½° Tw., 80 to 90° F. (in spray pits or in slack washers).
4. Wash thoroughly.
5. Sour ½° Tw. sulphuric acid.
6. Wash thoroughly to white pit.

Use of Kieropon in Standing Bath.—The accompanying Chart "A" shows that a Kieropon-caustic solution may be prepared and kept for two to three weeks with almost no loss in strength except the slight loss of about 5% which was caused by heating the solution to a boil. After the solution was allowed to cool the chart shows practically no further loss in Kieropon strength.

Loss of Kieropon Strength in Boiling Caustic Solution for Several Hours.—Chart "B" shows the gradual loss in Kieropon strength on continual boiling in different strength caustic-Kieropon solutions containing a medium grade of cotton cloth, in curves A, B, C, D, F, B_1 and C_1; Curve E represents the Kieropon loss in strength when boiling out a low-grade cotton fabric.

It is interesting to note that the loss of Kieropon increases as the strength of the caustic solution is raised, or the higher the pH the greater the decomposition of the Kieropon. Of course, the alkalinity of the bath is also used up during this boiling operation, although the loss in alkalinity is not shown in these charts.

The curves shown in Chart "B" apply only when using a process similar to the ones described in Formulas No. 3 and No. 4. We have found that when using a method similar to the one shown in Formulas No. 1 and No. 2, where the strength of the caustic and Kieropon is kept up during the run by adding a stock solution to the boiling-out box, there is only a very small change in the caustic or Kieropon strength, and these solutions can be used over again the next day by adding about 1 pound of Kieropon to every 100 U. S. gallons left over.

Chart "B" also shows that the loss in Kieropon strength

is reduced by keeping the bath at a temperature below the boil—i. e., 175 to 190° F.—indicating that a smaller amount of Kieropon can be used to perform a certain amount of work if it is possible to do the work at somewhat reduced temperatures. Careful study of Chart "B" shows that after six hours' boiling in a 3½° Tw. caustic soda solution the Kieropon loses about 50% of its original strength, whereas when the same strength of caustic solution was kept between 175 and 190° F. for the same length of time the loss in Kieropon strength was only 25%. It is also shown that when a low grade of cotton with a large amount of motes and sizing is treated in the caustic soda boil of the same strength a greater loss of Kieropon takes place, and consequently more Kieropon should be used to protect the colors and counteract the larger amount of reducing agents formed.

B—Use of Kieropon in Peroxide Bleaching

The usual method of bleaching with peroxide employs about 3 to 4% of peroxide and a small amount of silicate of soda to render the bath slightly alkaline. The usual temperature used is about 170 to 180° F. It is unwise to heat the usual peroxide bath to higher temperatures, due to the fact that the oxygen will be entirely liberated at the boil, and the alkalinity of the peroxide bath will cause the vat colors to bleed and tint the white portion of the fabric after the oxygen is all gone.

Greater bleaching efficiency from the peroxide bath would be obtained if it were safe to run the peroxide bath until the nascent oxygen from the peroxide was entirely used up in bleaching the material in the kier. Heating the peroxide bath to a boil seems to obtain the desired results better than by trying to run the bath for a longer time.

It is possible and safe to use the peroxide bleaching bath at 200 to 210° F. when it contains about one-tenth of 1% of Kieropon (based on the weight of goods), because the stable oxidizing properties of the Kieropon remain to protect the vat colors in the hot alkaline bath after the peroxide is exhausted. The very small additional expense of one-tenth of 1% of Kieropon which is used is more than offset by the greater safety and the better white and softness obtained by using the Kieropon in the peroxide bath at the higher temperatures.

The Kieropon should be added to the peroxide bath slowly and only after the entire amount of water is added to the charge. If it is necessary to make up the charge in two or more lots, the Kieropon addition should be divided equally in the different charges. If this precaution is not observed, there will be a polymerization of the Kieropon and the peroxide bath will assume a deep red or maroon color that would not be safe to use.

When the Kieropon-peroxide method is used properly the bath has a light yellowish color, which is washed off very completely after the bleaching operation is over and the material is left with the desired whiteness and softness.

II—Use of Kieropon in Mercerizing Vat, Naphthol and Sulphur Colors

The addition of about 3 pounds of Kieropon per 100 U. S. gallons of mercerizing strength caustic liquor will permit mercerizing goods containing a vat, or sulphur color stripe or solid shades, without affecting the color. It has never been a particularly difficult proposition to mercerize most vat colors, with the possible exception of Indanthrene Violet BN, Indanthrene Yellow G and Indanthrene Dark Blue BO. These colors are so sensitive to alkalies of certain strengths that they need special attention in mercerizing and bleaching operations. The use of Kieropon in the bath prevents the possibility of these colors marking off or bleeding.

The sulphur colors are protected in mercerizing with caustic soda when Kieropon is used in the mercerizing bath, and this now permits obtaining valuable new finishes on this class of cotton goods at very little increase in cost.

III—Kieropon Resist Under Vat Colors

It has never been possible to secure satisfactory white discharges on the faster type of vat colors, and the discharges on the less fast vat colors have been very costly to produce.

The use of Kieropon as a resist offers a very interesting and fertile field for investigation in order to produce the same effect on the fastest type of vat colors and at a very much reduced cost. The steaming operation which is generally required is not necessary in the Kieropon resist process.

The following paste is printed on the prepared cloth: British gum thickener, 10 gallons; Kieropon (dissolved in caustic soda), 3 to 5 pounds; acetic acid, to render paste acid.

The necessary amount of Kieropon is dissolved thoroughly in the least amount of caustic soda possible to give a perfect solution. The caustic-Kieropon solution is thoroughly mixed in the proper thickener and finally the acetic acid is added until the paste is distinctly acid. The material is then printed, dried and dyed on the pad with vat colors or sulphur colors. The dyed pieces are washed (soured if necessary), washed and soaped, and the Kieropon resist leaves a white pattern on a colored ground. The white effect would be improved, if the cloth were not previously bleached, by giving a light chemic after dyeing, etc.

The Kieropon probably acts as a combination chemical and mechanical resisting agent. It may be helpful to add a certain amount of zinc oxide paste to the resist. Further research is being conducted on this particular process and more information will be available later.

IV—Use of Kieropon in Laundering Colored Goods

Kieropon has never been used in laundries for the purpose about to be described, but inquiries have been made whether this product could be used to protect the colors from bleeding in laundry processes. It is very possible that a satisfactory method could be worked out for giving a short caustic soda-Kieropon boil to very dirty and stained towels and sheets, etc., from hotels, dining rooms, hospitals, etc., where the fabrics might have been misused for wiping oily hands to shining shoes or mopping the floors. The caustic treatment would be very apt to loosen the stain and a light chemic would give the goods a beautiful white. This method is only a suggested one and would probably be worth working out further.

The general understanding and use of Kieropon in bleaching operations, etc., has been steadily increasing, and new and improved methods are constantly being worked out in the trade which tend to reduce the bleaching and finishing costs and remove many former dangers encountered in handling colored goods.

I have some Kieropon resist samples here. These were dyed in beakers for about a minute. It shows that the Kieropon resist holds up even through that stirring around in the beaker, which would tend to break up a mechanical resist.

Here is GCD resisted perfectly.

That is Indigo.

There is Indanthrene Red.

Here is a Violet BN.

This one shows that it is not a case of just a mechanical resist, because here there were two pastes printed on. This one had the Kieropon in it, and this was the same, with the exception that the Kieropon was not in it. This one did not resist the dyeing, and this one did. These were block prints and mechanically they were not entirely perfect, but chemically they showed the process up very well.

I have overstepped my time limit. (Applause.)

Discussion on Kieropon

President Killheffer—We were a little late in starting, and therefore we ran a little over the schedule.

If there is any discussion of this paper, now is the time for it.

Mr. Thompson—There may be some who came in late who didn't hear all of the paper, and who would like to get this information. For those people I have some booklets here that I will be glad to give to those who would like them. If anybody is interested I will leave them over here.

Dr. H. C. Chapin—Just what is the function of Kieropon? Is it a stabilizer against change in oxidizing potential?

Mr. Del Plaine—The function of Kieropon is to act as an oxidizing agent. In other words, it is more easily reduced than the vat color itself, so that any reducing action that is going on caused by a reaction between the caustic and cellulose, or the impurities in cloth, would react with and reduce the Kieropon before it would react with the vat dyes.

Dr. Chapin—Then, in the kier it serves as a stabilizer against too great an oxidizing action from the air—

Mr. Del Plaine—No; in the kier it prevents the reducing action. You see, you have a reducing action of caustic with cellulose and impurities in the cellulose itself, and that reaction is just enough there when you have a pressure in local areas so that the vat dyes are marked off onto the whites. When you have the Kieropon there, there is enough oxidizing action to prevent the reducing action of the caustic and impurities from reducing or dissolving the vat dyes.

J. J. Sokolinski—Did I understand you to say, Mr. Thompson, that if you add one-tenth of 1% of Kieropon to the peroxide bleach it retards the decomposition of the peroxide?

Mr. Thompson—No; it has no effect on that at all. It simply serves to protect the colors after the peroxide is entirely decomposed.

Mr. Sokolinski—Is that true if it is a particular alkali, as you say, up to 10 pH? For instance, is it for caustic, or silicate, or soda ash?

Mr. Thompson—It makes little or no difference. It won't cause bleeding if it is on the acid side.

Mr. Sokolinski—Because a high percentage of the silicate in the bleach is far more beneficial to the colors than caustic soda, or soda ash?

Mr. Thompson—Even a mildly alkaline condition in the exhausted peroxide bath will cause many of the vat colors to bleed, if they are packed under pressure and heat, as they always are in this process.

M. L. Griffin—If the mechanism of this Kieropon ordinarily is such that it reacts to the impurities, reducing the action of the impurities, how about it in the peroxide bleaching, where you have an oxidizing agent? What is the mechanism of that?

Mr. Thompson—As long as there is any peroxide there, Mr. Griffin, there will be no need of the Kieropon at all. It is only to protect the colors when the peroxide suddenly is exhausted, and then it is necessary simply as a safety valve. The trouble isn't always a direct printing off of

tne colors. Sometimes, in bleaching towels containing various colored stripes, the different towels will show that the white is affected by the borders. For instance, a violet-bordered towel will have a violet-white; a green-bordered towel will have a greenish white, and an orange-bordered towel will oftentimes have an orange cast. It is quite difficult to make a good-looking selection of towels where the different colored borders are put in the same package, unless you give each individual style of towel a separate blurring, and that is not always convenient. It is much better to bleach them all in the regular way and depend upon the process of bleaching for keeping the white the same on all the different colored borders.

R. M. Fuoss—Does one ever have to reckon with the possibility of the Kieropon staining whites?

Mr. Thompson—Not if they have become acquainted with its use. To the folks who have not tried it before, it represents quite a problem; but it is just one of those things that, once shown how to use it, works out very well. But when we first started introducing this new method it was quite a problem.

Mr. Fuoss—Just what is the main danger?

Mr. Thompson—It just scares you. It comes right out. If you have a little faith and confidence it is all right, but for the time being it would seem that the goods would never be pure white again. No danger is done to the goods, as the Kieropon color is removed thoroughly by the treatment with acid, chemic or peroxide.

Mr. Harkins (Newport Chemical Works)—Has that any effect on wool in preventing colors from bleeding, cross-dyed effects?

Mr. Thompson—It has not seemed advisable to use it on wool, due to the fact that wool is a nitrogenous compound and this particular substance might give a very irremovable stain on wool. I know that when you work with it with your hands, if you don't wash it off quickly enough you look like a mulatto or Indian for about three weeks, and when you get it on your suit it is almost impossible to get it out if your suit is made of wool. So it wouldn't be good at all for that purpose.

President Killheffer—I am sorry, but we will have to shut off this discussion now and go on to the next paper. (Applause.)

Our next paper is, "The Bleaching of Cotton Goods in Kiers with Hydrogen Peroxide," by Mr. Smolens, of the Buffalo Electro Chemical Company. (Applause.)

Bleaching Cotton Goods in Kiers with Hydrogen Peroxide

By H. G. Smolens

Consulting Engineer, Buffalo Electro Chemical Company, Buffalo, N. Y.

ANY number of hot alkaline solutions of hydrogen peroxide will bleach cotton. All the ordinary commercial peroxides, which do not break up entirely at higher temperatures, may be used in such solutions. For any standard white the cost of a peroxide bleach depends on the money value of the peroxide used, which can be determined only by an actual practical test in your bleacheries, not by a laboratory experiment or by the results someone else is apparently obtaining.

At the present time there is no longer any great amount of doubt in the minds of bleachers about what peroxide bleaching can do to cotton, physically and chemically. But there still exists much reasonable doubt and skepticism about the practicability and the economy of the peroxide bleaching processes. Therefore the selling of peroxides for bleaching cotton today is more of an educational than a sales proposition, which apparently the manufacturers of peroxides do not yet realize.

Alkaline solutions of hydrogen peroxide bleach cotton best at temperatures close to a boil (212° F.). For this reason it is possible to simultaneously boil out and bleach cotton goods. This is the *big* factor of peroxide bleaching which makes a peroxide process comparable in cost with the conventional chlorine process.

Furthermore, it is possible to give cotton a full, level and permanent white in a peroxide boil with a loss in weight ranging from 0% to 2%. This means that a great deal, if not all of the natural waxes and oils are bleached without removal from the fiber. The result is more weight per yard of goods which is reflected in easier finishing and better feel. Of course such goods are not very absorbent, but some bleached goods do not have to be very absorbent. Where white goods are sold on a weight basis the income from the additional weight left by the peroxide bleach may more than pay for the entire cost of this bleach

Within the past two years we have learned how to use caustic soda properly in a peroxide bleach. This has made it possible not only to produce better and more economical whites but also to turn out bleached cloth which may, as desired, be almost waterproof or exceptionally absorbent.

The three chemicals necessary to the successful and economical peroxide bleaching of cotton are hydrogen peroxide, caustic soda and a buffer for the caustic, usually silicate of soda. These chemicals are so convenient to handle and so easy to manipulate and control that their proper combinations along certain basic lines will solve almost any kind of a cotton bleaching problem in any type of equipment. For cotton goods in bulk, this means kier bleaching.

What is ordinarily known as a kier is not the proper type of equipment for the best and cheapest peroxide bleaching of cotton goods, but in a great majority of bleacheries it is the only apparatus available, so that

the peroxide bleaching process must be adapted to it. At the present time we do not know exactly what form the ideal peroxide bleaching equipment will take, but quite a little thought is being put upon this subject.

Generally speaking, three physical conditions are essential to successfully bleach in kiers with hydrogen peroxide: (1) A thorough boiling (200°-210° F.); (2) a method of positive circulation and quick penetration; (3) a system of venting for the artificial removing of the gases which are part or a by-product of peroxide bleaching.

Thorough Boiling

Kier bleaching with hydrogen peroxide is done at atmospheric pressure, so that either there is no cover to the kier or an exhaust pipe is kept open during the boiling. There have been at least two attempts, both accidental, to apply steam pressure to peroxide bleaching. In each case the white was extraordinarily beautiful, but most of the goods had to be removed with a shovel. The closer we get to an actual boil, without boiling over the kier, the better the bleach and the shorter the bleaching time. In either pump or injector kiers, direct steam, not an outside heater or a heating coil, is recommended as the medium for heating the liquor because it is cheaper and quicker and because it can be made to vent the kier.

Positive Circulation and Quick Penetration

It is entirely possible to do successful peroxide bleaching in any pump or injector kier without any change in the existing piping.

The physical problem in such kiers is to obtain the nearest possible conditions to the three mentioned above. A manipulation of the liquor level, the proper heating of the liquor and the most effective use of the existing circulation apparatus are all necessary. But usually the capacity of these kiers must be reduced to about 65% or 75% of their customary load for pressure boiling. This is one reason why the loading of an ordinary kier by an automatic piler makes it much easier to get a good peroxide boil.

The chemical problem of such kiers is to use the hydrogen peroxide, the caustic soda and the silicate of soda in such quantities and proportions that the liquor retains an effective bleaching strength for the entire time that is required to penetrate and bleach the innermost parts of the mass of cloth in the kier. Otherwise the bleach may not be white enough, even enough, or the cloth may come out of the kier with many parts entirely unbleached.

On account of these physical problems which reduce so materially the capacity of ordinary kiers and of the chemical problems which make it very expensive to use these kiers for peroxide bleaching, many attempts have been made to devise piping diagrams and circulation systems for kiers which would overcome these problems. Some of these diagrams and systems have even been patented, but they all use ideas which are inherent to parts of bleaching or dyeing equipment which have been in use for years.

There is no doubt that the proper alteration of or addition to the ordinary circulation system of a pump or injector kier greatly reduces the time and the cost of a peroxide bleach. The reduction of time is due to the speed with which all parts of the mass of cloth may be penetrated with the bleach liquor, the reduction in cost to the decrease in the amount of bleach chemicals necessary to give the desired results. In every kier bleach with peroxides there is considerable loss of hydrogen peroxide due to the catalytic action on the peroxide, by the structural materials of the kier system and of the impurities in the cloth. This loss is a function of the length of the boiling period, naturally, a shorter boiling period means a smaller catalytic loss. Therefore, less peroxide bleach chemicals may be used in the initial liquor without affecting the result.

Venting

In every peroxide kier boil there are at least three gases which appear in varying amounts: oxygen, steam and air. A pocket of any one or all of these gases trapped within the mass of cloth in a kier is impervious to the passage of the bleach liquor. As a result such a pocket will produce an unevenly bleached or an unbleached spot in the cloth. This is why it is so essential to remove all gases from the kier by artificial means, which must be positive, practical and cheap. It is surprising that almost all bleachers heretofore using peroxides in their kiers have paid no attention to this important point.

The easiest and most economical venting system for any kind of a kier makes use of the direct steam with which the kier liquor is heated to produce also a suction throughout the entire height of the kier, which removes all gases from the cloth. A good venting system also prevents an uneven rising of the goods during a peroxide boil and thereby practically eliminates the possibility of tangling or turning over of the mass of cloth.

There are two general processes of kier bleaching with hydrogen peroxide—the *one-boil bleach process* and the *two-boil bleach process.*

The one-boil bleach process consists of the following operations:

1. Gray goods singed and desized if necessary.
2. Gray goods run through a plain water wetout box.
3. Gray goods piled into kier.
4. Peroxide boil—two to six hours at 180° to 210° F.
5. Bleached goods drawn out through a washer.
6. Bleached goods sent to finishing department.

The *two-boil* bleach process consists of the following operations:

1. Gray goods singed if necessary.
2. Gray goods run through a plain water wetout box.
3. Gray goods piled into kier.
4. First peroxide boil—two to five hours at 180° to 210° F.
5. Half bleached goods drawn out through a washer and piled into another kier.
6. Second peroxide boil—four to eight hours at 180° to 210° F.
7. Bleached goods drawn out through a washer.
8. Bleached goods sent to finishing department.

It is desirable but not absolutely necessary that the peroxide bleach liquor be made up in an outside mixing tank and run into the kier from the bottom up It is essential that the goods should not be chained or weighted down in the kier. The mass of cloth must be allowed to rise as freely and as high as it will go So long as there is active peroxide in the bleach liquor the cloth will stay up. One or one and one-half hours after a kier liquor shows no peroxide, a bleach boil should be stopped as it is no longer effective. When the venting system is working properly the cloth near the vents will rise slightly above the rest of the mass on account of the accumulation of gas at the vents. If the kier load of cloth does not rise and drop back in the course of a peroxide boil the bleach is usually not successful.

There are ordinarily three classes of goods, which, for economy and production, must be bleached in kiers: (1) Goods with colored designs, stripes or dots, for white; (2) plain goods for white; (3) plain goods for dyeing or for printing.

Goods Containing Dyed Yarns, More or Less Fast to Bleaching

The object here is to get the fullest possible white and at the same time retain the colors at their gray goods shade and fullness. This kind of goods, such as toweling or marquisettes, is usually not dyed after bleaching so that it is not necessary to make it exceptionally absorbent. A one-boil process therefore is customary for colored goods. Should the loose or surplus color of the stripe or design run so that the kier liquor becomes colored and makes the goods look dingy, a soaping off directly from the kier and before washing is very desirable and quite effective.

Colored goods, such as the highest grade toweling, that has to be not only very clean looking, but also very soft and quite absorbent, is bleached by the two-boil process.

Goods made from waste or very dirty cotton should ordinarily be given an alkaline kier boil, without pressure, as a cleansing scour, before the peroxide boil. A great deal of toweling is handled in this manner.

Goods made from soft spun yarns which are not very tightly knitted or woven and which do not have to be very absorbent, are quite successfully bleached by the one-boil process. Such bleached goods will take blue and starch evenly. The whiteness obtainable depends on the quality of the cotton and on the formula used. Underwear cloth, some types of dress and curtain goods, and book cloth are processed in this manner.

Goods made from hard twist yarns, tightly woven, must nearly always be bleached by the two-boil process. Such goods are very absorbent, take blue and starch evenly and come from the calenders or tenters with a beautiful finish. Ordinary sheeting, for example, bleached by the two-boil process has the very desirable linen-like appearance and feel.

Goods for Dyeing or Printing

A great deal of the success of dyeing and printing, especially with vat colors, depends on the bleached bottom that comes into the dye-house. This bottom must be thoroughly absorbent, without resist spots or streaks, and must have a whiteness that will allow the dyeing of the brightest or thinnest pastel shades without cloudiness or dinginess. A good peroxide bleach boil has no injurious effect on the cellular structure of the cotton fiber, so that this cause of trouble in chlorine bleaching automatically disappears. It gives the finest whiteness that cotton can take without over bleaching. The action of a boiling solution of hydrogen peroxide and caustic soda at atmospheric pressure, is extraordinarily effective for removing, mainly by oxidation, the foreign ingredients of cotton which prevent absorbency, without any pronounced tendency to the production of oxycellulose. In many cases a peroxide bleached bottom has taken a fuller and deeper shade from the same formula (direct colors) than a chlorine bleached bottom.

Any particular quality of cotton require a fairly

definite quantity of hydrogen peroxide for a full bleach. This makes the chemical cost of a one-boil bleach process about the same as that of a two-boil bleach process.

Kier bleaching of cotton goods with hydrogen peroxide has now been developed to a point where the cost of chemicals is about one-half cent per pound of cloth bleached. By taking into account the great difference in the time of bleaching, the difference in steam and water consumption, and the difference in overhead, the total cost of a hydrogen peroxide bleaching process is just about the same, on the average, as that of the conventional chlorine bleaching process. But there is quite a difference in the quality of the finished cloth—in favor of hydrogen peroxide bleaching.

Discussion on Peroxide Bleaching

President Killheffer—Is there any discussion on this paper?

M. L. Griffin—Mr. Chairman, and Gentlemen: I only want to speak very briefly on this matter. It is a very pretty problem when you can get away with one process, when formerly you had three or four.

Of course, in the bleaching of cotton, ordinarily you have the caustic boil and you have the chemic, with the washings, and so on, that go on in between. If you can accomplish the whole thing in one process, of course, you see where you get off. You effect a great saving, commercially. But you will notice that the speaker referred to a good many cautious points along the line.

The reason why, in the older process of bleaching, you get three or four boils is because of ineffective circulation. There are many fabrics which are very closely woven and tightly twisted, and it is not easy to get perfect circulation in the kier when it is well charged. The speaker made some reference to that.

Of course, if you could preserve the entire alkalinity of a peroxide, as well as preserve the oxidizing power of it in kier boiling with peroxide, you might have an effective chemical action, and the matter of adding a buffer of silicate of soda, of course, goes quite a way. But we do know that peroxides are preserved in massive solutions and there is a degradation or a loss of the oxidizing power proceeding. I was very glad to see a chart showing the loss of active oxygen in the process.

I think the time will come when we will bleach in a continuous open width. The thing can be done. It has been talked about for a long, long time.

The only suggestion I want to throw out is that with the old-time chemicals you can make a hypochloride as alkaline as you please and get the effect of both the alkalinity and the chlorine oxidizing in that way.

President Killheffer—Is there anything further, gentlemen, on this particular paper?

Dr. H. C. Chapin—Do I understand that in filling your kiers with the piler you don't have to flush down?

Mr. Griffin—They don't get as much into the kier.

Dr. Chapin—I understand, Mr. Smolens, that you pile more loosely, and probably you would not have to flush down as you pile.

Mr. Smolens—The automatic pilers all have to wash down. In fact, in peroxide kier boiling with an automatic piler you wash the cloth in with the kier liquor which is prepared right in the kier or in mixing tank, and the pump washes the cloth right in with this kier liquor.

Dr. Chapin—I understand that one of the problems in piling kiers is that such a large amount of flushing liquor has to be used to pile the kier tightly that it is rather difficult to maintain the concentrations.

Mr. Smolens—The same kier liquor can be used over and over again, circulated through a pump for washing the goods into the kier, but I have never seen a kier piled by an automatic piler that came within 15% or 20% of the rating capacity of the kier.

President Killheffer—Are there any further questions?

Mr. Sokolinski—I should like to ask Mr. Smolens a question. In an iron kier that is properly coated isn't there less chance of decomposition than if you used a wooden kier? With a wooden kier there is always a certain amount of oxygen being used up by the wood itself; particularly if you should give the light caustic, there is always a certain amount of coloring matter that comes out and that in turn uses up some of the oxygen in bleaching that coloring matter. Then, with the coloring matter in the fiber itself, isn't it true that there is more chance for uniformity in the iron kier?

Mr. Smolens—All the records that we have show that we can use less peroxide in bleaching in wooden kiers than we need to use in bleaching in steel kiers.

Mr. Sokolinski—You use less?

Mr. Smolens—Not very much less.

Mr. Sokolinski—That is certainly very interesting.

Mr. Smolens—We do not do any caustic boiling at all.

Mr. Sokolinski—You have your alkalinity there in your bleaching liquor, itself.

Mr. Smolens—Yes, very much alkalinity.

Mr. Sokolinski—Wouldn't it be more advantageous in the first boil to use a very small per cent, and by that means your alkalinity would remove your coloring

matter, and then strengthen up on the second bleach, which would only attack the coloring matter in the fiber?

Mr. Smolens—We don't think it is the alkalinity that removes the coloring matter.

Mr. Sokolinski—No, but it has quite an effect on the cleansing property.

Mr. Smolens—A boiling solution containing hydrogen peroxide and a very small amount of caustic soda is very much more effective as a cleanser than a boiling solution containing perhaps 160 times as much caustic soda alone.

Mr. Sokolinski—Naturally, because your caustic soda decomposes the bath, but if you used silicate there, wouldn't you derive more benefit from your peroxide?

Mr. Smolens—Silicate of soda is not supposed to do anything except buffer the caustic.

President Killheffer—Is there anything further?

W. F. Deady—I should like to ask the speaker if he has ever run any comparative tests between peroxide bleaching and chlorine bleaching on the same type of goods, and did he get any better gains on his peroxide bleaching?

Mr. Smolens—In every case.

Mr. Deady—How much better?

Mr. Smolens—On goods like marquisettes, for example, in which the finisher makes his profit on the overage, we have had several cases in which there was at least 5% greater overage out of the peroxide bleach than out of their chlorine bleach. That means there was more of something left in that goods; otherwise, they wouldn't have been able to pull it and maintain their width as much.

Mr. Deady—Have you ever done it on any heavier goods?

Mr. Smolens—Sheetings.

Mr. Deady—What weight?

Mr. Smolens—From 2.54 on 30-inch cloth to about 1.68 on 81-inch cloth. There is always more weight per yard of cloth out of the peroxide bleach, and that doesn't affect the absorbency, either, because that cloth can be dyed very level. In fact, in a great many cases we have run tests on sheetings that have gone through a peroxide boil and have been dyed with direct color, and the same formula will produce a fuller shade and a brighter shade on a peroxide bottom than on a chlorine bleached bottom.

Mr. Deady—What do you consider is that exact weight that is left in there? What does the caustic take out that the peroxide leaves in?

Mr. Smolens—We hope it is cellulose. We don't know.

President Killheffer—Gentlemen, we will have to terminate this interesting discussion.

Another change has been necessitated in the program due to the fact that Mr. Byam, who is on the program for eleven forty-five, must get away. We had moved him forward to the afternoon session, but now we will put him back where he was formerly. Mr. Byam is to present a paper on "Manufacture of Rubberized Cloth and Attendant Dyed Cloth Problems." This is something that I assume is of a good deal of interest and there may easily be some problems involved that will be very interesting to our Research Committee.

Mr. Byam! (Applause.)

S. G. Byam—Mr. President and Gentlemen: I should like to say at the start that, while I am with the Du Pont company at Fairfield, I am presenting this paper as a representative of the Rubber Association of America, representing the proofing or rubberizing division of that association. The industry I represent is very grateful to Mr. McGowan, of the Cotton Textile Institute, for arranging this opportunity and to this organization for permitting us to present our ideas to you. This is a contact between one trade association or one industry and another, and it is our purpose merely to sell you the idea of producing better fabrics for us.

Manufacture of Rubberized Cloth and Attendant Cloth Dyeing Problems

By S. G. Byam

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THE industry occupied with the rubberizing of fabrics has received scant attention in the literature of rubber, chiefly because its rubber consumption is so trifling in total as compared with that of the tire industry. The tire business so completely overshadows the smaller branches of rubber manufacture, that we have suffered in technical development. This is, of course, our own fault, but we are gradually waking up to the fact that we do amount to something and that that something is worth enlarging. The past few years have seen a remarkable growth in the use of our products and in the development of our technical skill. We hope to continue this progress by improving every factor involved in this business.

It may seem that in the following paper we devote too much time to manufacturing and technical matters pertaining to rubber itself, rather than to the cotton in which you are interested. However, we believe you may know less about this than does the speaker, thereby giving him some slight advantage, whereas when we discuss fabrics we know we are

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talking to experts. It is entirely reasonable that we should give consideration to our fabric requirements, for cloth, and usually cotton cloth, is the foundation of our product. It is surprising, rather, that we have operated so many years without collectively having told you what we want. There are individual exceptions on both sides. Some of our proofers have known what was needed in the way of fabrics (and obtained them) and some of the textile manufacturers have known what to supply. We hope in telling you something about our manufacturing scheme, and why we ask for certain requirements, you will realize our needs and work with us on them.

There have been occasions when we have felt that the textile people did not care to co-operate particularly. For instance, we have been told that strength guarantees on fabrics were taboo, and that we could not properly demand that a fabric should test to a certain tensile strength that we have known from experience was average. It seems obvious that we should have need for a guaranteed tensile strength, and that the textile industry should be able to control their operation to such an extent that it might be provided. We have noted a somewhat different trend lately, indicating the cotton goods manufacturers would at least recognize this requirement, and we are otimistic enough to believe that such will be the case when we have definitely told you what we need and why we need it.

The Development of Rubberized Fabric

It is known that for many centuries rubber has been used for coating fabrics for protective apparel. We have the reference by Schidrowitz that it is on record that the Spanish invaders of South America waterproofed their cloaks with rubber latex. It is also claimed that the natives of the Amazon district later added sulphur to the latex before spreading it on the article, as they found that goods made by this process kept longer. There is also a reference that in 1791 a Samuel Peale, of London, worked out a method for spreading hot rubber on cloth, though with considerable practical difficulty. In 1825 Charles McIntosh, of Manchester, England, produced his double texture waterproofed garment, using rubber as the combining medium. With this operation we really have the start of the proofing or rubberizing industry, and the type of material McIntosh made has retained his name to this day. In 1839 Charles Goodyear discovered the fact that rubber treated with sulphur in the presence of heat took on new properties which proved to be of unusual value. This discovery, of course, gave the rubber industry its technical commercial beginning.

After Goodyear's discovery the art of manufacturing rubber goods progressed, though slowly, until the advent of the motor car and pneumatic tires, when advancement became phenomenal. The rubberizing of fabric has been carried on commercially with processes developed during the middle and late nineteenth century period, and has only slightly changed as to essentials up to the present time.

The production and use of organic accelerators, together with present-day efficiency of manufacturing is fortunately making us realize that much can be accomplished in the proofing industry and that a considerable advancement in development of product can be made. It is felt that much improvement in the manufacture of rubberized fabrics lies in a thorough understanding of curing processes and that some discussion of this matter might be carried on to advantage, hence these comments on curing. It should be apparent from this article that we have a great deal of confidence in dry heat curing for rubberized fabrics, but it must not be assumed that we have an idea that other frequently used methods of curing are necessarily inferior. We refer particularly to the sulphur chloride cure which is in common use. This method of curing has advantages, specifically with regard to speed, economy and effect (or lack of effect) on the rubber surface, and does, without question, produce goods of excellent value for certain purposes.

Regardless of the entire mechanism of the sulphur chloride cure it may be considered that sulphur monochloride adds directly to the rubber molecule, producing properties of elasticity, freedom from effects of temperature changes and strength similar to those resulting from a heat-sulphur cure. The speed of reaction is so fast as to be practically instantaneous and therefore the cure is effected chiefly at the surface of the rubber. The penetration of the sulphur chloride into the rubber is automatically retarded as the time of exposure is increased because of the rapid hardening action at the surface.

This condition constitutes the chief limitation to the use of this type of curing, for only thin films of rubber will be adequately penetrated to produce uniform and ample cures. A further most important step in the proper handling of this cure lies in the complete neutralization of the excess sulphur chloride. This chemical has a strong affinity for water and is readily hydrolized by it, with hydrochloric acid as one result of the reaction. Therefore, excess sulphur chloride contained in the cured material may be easily changed to hydrochloric acid by atmospheric moisture with the

result that unpleasant decomposition of the rubber may take place.

Manufacturers have found that a thorough exposure of the cured goods to aqua or gaseous ammonia will neutralize any excess sulphur chloride as well as any hydrochloric acid which may be present. In addition, inorganic alkalies, such as lime and magnesium carbonate, are usually incorporated into the rubber compound to further act as inherent neutralizers of residual sulphur chloride or acid. This neutralizing operation may not at any time be neglected or its necessity questioned if material is expected to have reasonable life. It has been found that anhydrous ammonia may be used effectively and easily and that it is more positive in action due to its being used in greater quantity, usually, than the aqua ammonia, which is commonly used. The sulphur chloride cure can be used for both calendered and spread fabrics but has more general favor with the latter type, on account of their being generally lighter in weight and thinner in rubber film.

Dry Heat Curing

The dry heat or oven method of curing is probably the simplest application of Goodyear's discovery that rubber and sulphur unite chemically in the presence of heat. The method as now practised has been used by the trade for many years, and early descriptions contained in the literature differ very slightly from present procedures.

It sometimes seems surprising, in view of the excellence of heat-cured rubberized products that the proofing trade has not used this process to a much greater extent rather than the sulphur chloride cure. However, there have been reasons why the dry-heat cure has not been generalizd more, such as the difficulties of operation and long periods of time required for dry heat as compared with the simpler conditions for "acid" cures. This condition is changing as chemists study the quality of their products and realize the possibilities of modern accelerators, organic colors, and helpful chemicals like the anti-oxidents. It is an indication of progress that an increasing number of dry-heat cured products are coming on the market and that the demand is growing with the trade using rubberized fabrics for heat-cured goods. The tendency in this direction cannot help but produce a healthy business condition by the production of goods of better quality and through this the creation of more uses for rubberized products.

The outstanding product, which has always been heat cured, is carriage cloth or, as it is now termed, automotive top fabric. That this product should have been always heat cured is natural because the conditions of manufacture permit no other method being used. Carriage cloth is relatively heavy in weight, usually has a varnished surface which must be dried or baked and must withstand in service severe exposure to all kinds of weather. Only dry heat curing, together with proper compounding, of course, can meet the test.

For years the dry-heat cure was limited to the use of litharge for acceleration, which fact permitted the production of only black and dark colored goods. We have now stepped beyond this boundary and with organic accelerators are obtaining any brilliant or delicate tint or color desired. In the case of colored material for carriage cloth a further limiting condition has been that black compounds have aged vastly better than colored ones. However, these limiting features are all being overcome or nullified by technical skill in producing better compounds, long-wearing varnishes and other surface effects in color as well as in black. Perhaps the dry-heat cure should be given some measure of direct credit for the excellence of the varnished finish of modern carriage cloth, which is well known to last the life of the car in providing perfect protection with a reasonable amount of permanent good looks. The cure plays an important part in properly drying and oxidizing the oils of the varnishes.

Vogue in Rubberized Goods

In the rubberizing industry the raincoat trade is probably the largest consumer of rubberized fabrics, though the automobile trade requires almost as much. Except during periods when double texture fabrics have been in vogue for raincoats, dry-heat cured materials have been used only slightly. The vogue for leatherettes during last season and carrying on this year is a notable exception to this statement, for leatherette is a dry-heat cured product. It is a fact that the double-texture coat has been the most serviceable type of all, credit being due in part to the general excellence of the rubber film between the fabrics and to its being toughly cured with dry heat.

In applying tests to assure the quality of the finished product one should, of course, make use of those affecting raw materials. The tests for impurities in compounding ingredients are too well known, besides being irrelevant to this discussion, to mention, but it would not be well to avoid mentioning testing dyed fabrics for dangerous chemicals. It is generally known that copper salts accelerate to an unusual extent. The oxidation of rubber and their presence in fabrics to be rubberized may not be tolerated with impunity.

Decomposition of rubber due to the action of copper is extremely unpleasant from a sales, as well as from a technical point of view. Even small amounts of copper present in dyed fabrics will cause decomposition, C. O. Weber claiming that as little as 0.01% will cause deterioration. The rubberizer must go far below this figure for his maximum tolerance of copper, 0.005% not being too small for this limit.

It usually has been proofing practice to reject fabrics showing a qualitative test for copper by the simple nitric acid-ammonia method, but as this test is not sensitive to 0.005% copper it is considered more desirable and safer to determine copper by the quantitative colorimetric method. The action of the copper is considered to be catalytic to the production of SO_3 with the following formation of sulphuric acid, which is so deadly to rubber. It also seems to speed up the rate of oxidation of the rubber with the result that decomposition sets in earlier than it should.

While we have been more concerned with copper on account of its prevalence in dyed goods, manganese, chromium, iron and other heavy metals exert undesirable effects similarly on rubber and must not be present in dyed fabrics. Manganese is more active than copper, though fortunately less common. Record is at hand of the presence of manganese in gray goods, doubtless having come from washing water purified by permanganate..

We are now considering iron as an injurious chemical which should be prohibited in fabrics to be rubberized and it is thought that its elimination will constitute no great hardship for the dyers and finishers. Combinations of iron, manganese and copper seem to be more harmful than a single ingredient itself unless in excess, and it behooves the rubberizer to carefully check his fabrics for this chemical if he wishes to produce the long-aging materials his trade demands. Ferrous iron is particularly harmful in small quantities. Tests for these ingredients are being worked out and will be supplied with any specification eventually adopted, but will be based on standard methods of quantitative analysis modified to be as simple and accurate as possible. The oxygen bomb test for quality which is discussed later furnishes very definite evidence of the effect of copper, etc., in fabric on rubber.

At this point I refer to a sample of rubberized fabric which is made up for raincoat material and which has been exposed to the accelerated aging conditions of the oxygen bomb. The fabric was tested by the laboratory for copper, and so forth, and was pronounced satisfactory for use. On test in the bomb, it was found that it very readily decomposed, but that the decomposition followed a single stripe in the plaid back. When the conditions were studied, it was found that the dye in one of the red stripes was different from the dye in the other red stripes, and that in the one that gave the trouble there was copper present, with the result that decomposition followed the stripe containing the copper. It is a very striking example of the injurious effect of copper on rubber and it has made it necessary for us, in checking woven fabrics, to test every colored thread individually for copper manganese and iron.

Properties Determined by Tests—The Oxygen Bomb

Tests on finished product must include tensile strength, hydrostatic resistance, toughness of rubber film as determined by mechanical scrubbing, edge cracking, accelerated aging and such others as a particular need might require. Tensile strength of finished product is usually important regardless of the use the material will undergo. With single textures it may be considered that the raw gray goods strength is practically the same as that of the dyed rubberized fabric. That is, the loss in strength due to dyeing or bleaching is just about compensated for by the effect of the rubberizing. Rubberizing on a given fabric may add about 10% to the strength of the fabric unrubberized. It merely serves to hold the threads together, of course.

Incidentally, rubberizing tends to reduce tearing strength because it holds the individual threads apart from each other, so that in tearing you get the break of the individual thread and not the break against several threads, as you tend to get sometimes in uncoated fabrics. With double textures it is usually slightly higher on the combined product than the sum of the strengths of the two fabrics in the gray.

Knowledge of the strength of the material as well as the strength requirement for the service intended is very essential. Resistance to water pressure is, of course, an effective measure of the usually necessary waterproof quality of a rubberized fabric and its determination is simple with a standard testing machine similar to the Mullin tester for bursting paper. Edge cracking can be determined by hanging a strip of rubberized fabric over a sharp edge under constant tension and permitting weather exposure or accelerated aging to do its work at the same time and is a test which will provide much valuable information regarding the flexibility of a compound. The "scrub" test which similates the action of rubbing the coating surfaces against each other gives a measure of the toughness or abrasive resistance of the compounds.

The use of the oxygen bomb method of accelerated aging is rapidly supplanting all other methods of forecasting life in the proofing as well as in the entire rub-

ber industry. The drastic effect of oxygen at 300-pound pressure and 70° C. on rubber is showing up degrees of quality not realized previously. To the manufacturer of dry-heat goods the test is of primary importance in determining extent and uniformity of cure. The necessity for a means of doing this has been recognized for a long time, for the condition of variable temperature control in dry-heat curing is so hard to eliminate.

The bomb aging tests show relative effects of various accelerators on the compound, the value or lack of value of anti-oxidants on particular compounds, the accelerating or retarding effect of organic colors, and the very important fact that even minute quantities of copper in fabrics cause early decomposition of rubber. Many, if not all, of these conditions may be determined by other means than the bomb aging method, but not with such exactness or so rapidly.

There is the all important consideration of the relation of time of exposure of rubber in the bomb to normal aging to be considered and in this matter one hesitates to lay down a factor. It is thought that the time ratio very probably varies with the type of compound being studied, but because the condition of so-called normal aging is so indefinite and uncontrollable it seems ridiculous to attempt to establish any definite time factor. On some compounds a twenty-four hour exposure in the bomb may be equivalent to six months of normal aging, while with another type of compound one would not dare claim more than three months.

Bomb Aging—Practical Aspects

It is clear, however, that the actual ratio of bomb aging to normal life is of less importance than the established fact that details of compounding, effect of accelerators and colors and extent of cure show their relations to the life of the goods when exposed to bomb conditions. It seems safer, after one has had experience with bomb aging, to assume that material which stands ten days' exposure in the bomb is definitely and radically better in aging quality than if the material becomes visibly and adversely affected in five days.

While discussing this interesting subject one considers the end-point of the bomb test or, in other words, how does one tell definitely when the sample fails? At the present time experience seems to be the best answer. When rubber oxidizes, it resinifies and later hardens; therefore, when cracking occurs the material has failed. But it has failed also when it becomes resinous or mushy and if we work back to the start of decomposition we must find the point where softening occurs. In view of the fact that oxidation increases the acetone extract of rubber, determinations of this condition during the period of aging might furnish a basis for working out that point at which the material actually starts to fail. We know that there is a very sharp rise in the resin content of rubber where serious decomposition sets in and determining the point just prior to this rise would be the indication of the end of good aging for which we are looking However, as serious decomposition is entirely obvious because of the physical softness of the rubber and the rank odor of decomposition, it is unnecessary to chemically determine this point and we may as well rely on our experience for placing the point at which rubber begins to go bad in the bomb.

We would like to tell you much more about the technique of proofing, how our dry-heat ovens are constructed, what difficulties we encounter in operating, the danger of sulphur bloom and how little we know about it, etc., but time prevents at this meeting if we are to discuss our tentative specifications at all.

There are here other samples of aged fabrics which show an effect similar to that in the sample being passed around. These will be available later, if anyone cares to examine them. However, the effect is not radically different than that as shown in the little red sample which is being passed around.

Statistics and Styles

Any discussion between vendor and buyer always must bring out the potential consumption of the product in question if the latter expects to obtain special requirements. If follows, of course, that the greater the consumption, the greater the attempt the vendor will make to satisfy his customers' demands. The proofing industry has felt in times past that the cotton goods people were only very slightly interested in its business, that probably our yardage was only a drop in the bucket and did not warrant any special action on the part of textile manufacturers to satisfy this trade. It is true that for years our industry made little progress industrially and possibly we knew very little about our own requirements. Possibly when we asked for special fabrics we were unreasonable in our demands. Possibly also there were recognized standard fabrics available which were entirely suitable if we had known of them. On the other hand, possibly we would have used them if our cotton friends had suggested them to us, and perhaps we could have used a much greater yardage if more attractive fabrics had been submitted.

However, we are at last beginning to learn something about our problems and we believe that if we can give you some idea of them and of our fabric

requirements you will be more than glad to assist us in obtaining what we need. We feel that our consumption, which has increased from about twenty million yards in 1921 to forty million in 1927, with the probability of forty-four million in 1928, is sufficiently great to be of interest to the textile industry. It should be stated that these figures represent the cotton goods consumed by the rubber proofers, but do not include the yardage used by the automotive fabric manufacturers. The figures are based on reported statistics of production by the Rubber Proofers Division of the Rubber Association of America, which represents, conservatively we believe, 75% of the proofing capacity of the country. In the chart, the blue line represents a very accurate estimate of the total yardage consumed by this industry. The red line is an actual record of consumption as reported through the Rubber Association. It is not to be expected, perhaps, that the rate of increase of the past three years in particular can be maintained through the next three, but it is not unlikely that with your help we can more than maintain the present level.

This remarkable growth in the rubberizing industry

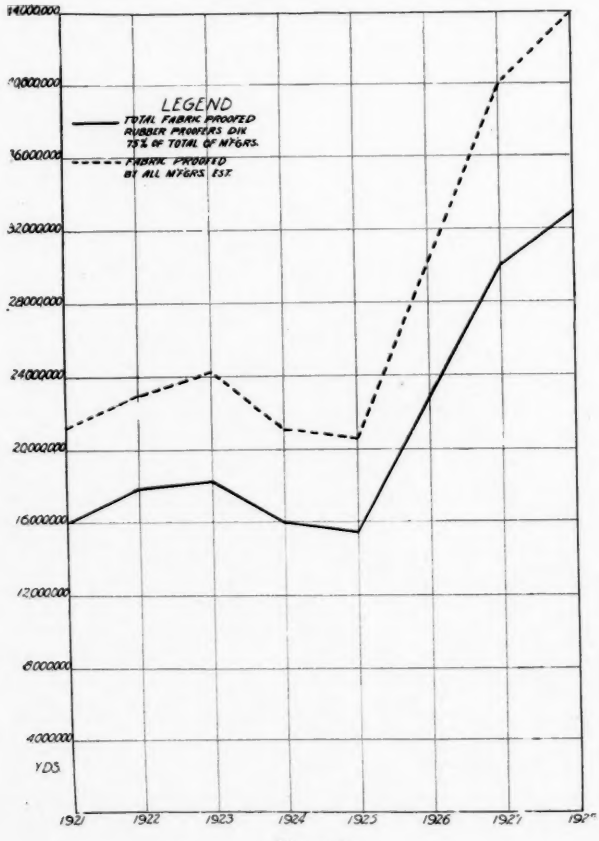

Chart 1

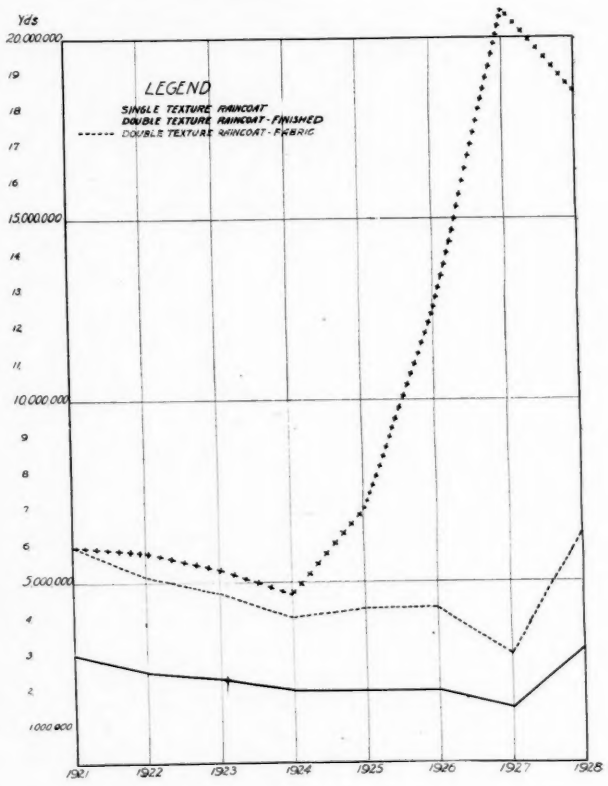

Chart 2

hinges upon the raincoat and sport coat business and is due to better and more attractive rubber coatings, to up-to-date and modish styling of garments, and to suitable fabrics. In considering these three factors on which the rubber clothing industry depends, we as rubberizers can control only one—that of applying the rubber to the fabric. We exert as much influence as we can on the apparel manufacturers by attempting to guide their style trends and by producing for them the attractively colored long wearing materials they use. The third factor belongs to the textile people and we are now attempting to get your help by suggesting through our proposed specifications our requirements and our reasons for them.

We wish to call your attention to a brief analysis of raincoat proofing. It will be seen from chart No. 2 that we subdivide this item into single and double texture materials, those having one ply of fabric rubberized and those having the rubber sandwiched between two fabrics. The first is shown by the cross line, the second by the plain line. The years 1921 to 1924 were rather transition years in our business, and in the raincoat line the war-time double-texture coat had passed. It was followed by a cloth surface, rubber-

lined material known as gas-mask fabric in the trade. This material made an attractive and serviceable coat —if the fabric used was strong enough. The material weighed when finished around 24 ounces per square yard, while the fabric commonly used was 5:35 64 x 60 print cloth weighing only 3 ounces. Although the gas-mask coat had a somewhat substantial wave of popularity for a couple of years, it could not really set well with the public because of the ease with which it tore. It was decidedly a gross mistake to use so light a fabric in so heavy a garment. We as rubberizers should never have permitted such a fabric to be used so extensively, though of course price always looms up as a big argument.

Style Shifts and Yardage Gains

It is significant in this connection that a single raincoat manufacturer during that time had the sense to use a sheeting counting 56 x 60 and weighing 3.60 yards per pound, instead of the 5.35 sheeting. The extra strength of that slightly heavier fabric was enough to overbalance this tearing difficulty and that one man ran a very substantial quantity of that particular material up until last year. In other words, he extended the life of a given product some three or four years beyond its normal run in the trade, and there is no doubt in my mind but that it was accomplished by his own wisdom in demanding a heavier fabric as the base of that material.

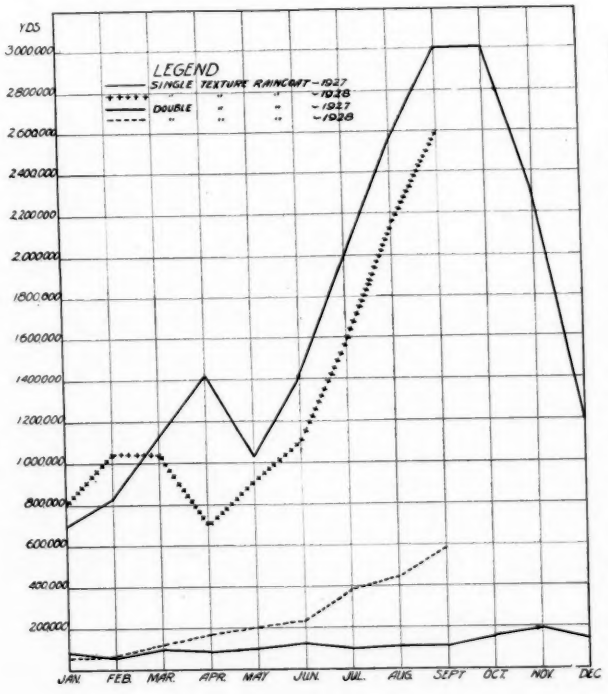

Chart 3

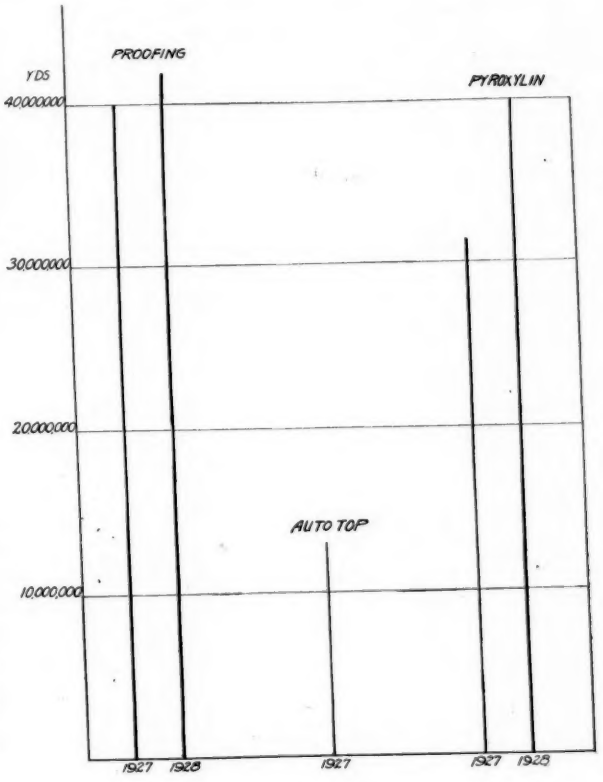

Chart 4

Gas-mask was followed by the very light weight, highly colored rubber surfaced material made on 5:35 Bombay. Here we put on a 4-ounce coating, producing an excellent attractive light weight, low price fabric. The proof of the wisdom of changing to this type is given in the very much increased production that resulted, and is evidenced in the chart by the increased yardage of 1925 and 1926. Of course, the Bombay coats were made chiefly for women and girls and had the popular appeal of color. From bombazine we evolved what we call leatherette, a shiny finished highly colored rubber surface material on a napped sheeting or flannel. This material was somewhat heavier than its predecessor, more attractive in appearance and was also stronger and more serviceable. The resulting coats were styled better and at once became tremendously more popular. The reflection of this popularity shows in the increase in the amount of fabric consumed during 1927 of over twenty million yards.

It can be seen that 1928 is also a leatherette year, even though our estimate indicates a two-million

yard falling off this year. The question we are interested in now is one that is of great importance to the textile industry, and is, what will be popular next year? It seems to be the case usually that there is a secondary type of material being consumed every year which bids fair to predominate in one of the years immediately following that of a popular number. The double texture of war-time never went completely out of existence and has been a back log of some importance during the past eight years. This year we find the use of double textures increasing with the popular trench coat. This is a comparison of the same year on a monthly basis. The peak in this case represents seasonal trends. The raincoat season is always in the fall of the year, with a decided slump during November and December. But the significant thing here is the increase over 1927 of double texture and the steady decrease over 1927 of leatherette.

Does the falling off of leatherette by 10% and the increase in double texture of nearly 100% over 1927 indicate the supplanting of the former by the latter? Possibly it does. Personally we believe that leatherette will be popular another year but that double textures will continue to increase also. The dotted line shows the yardage of fabric in double texture, indicating the value to the textile trade of this type of material. Attractive fabrics and attractively styled coats may put double texture over in a big way.

Seasonal Trends—Auto Topping

This selection of fabrics just represents types of raincoat fabrics that are in use and have been in use. The top one is a single texture Bombay material. I am referring for a moment to this one which, if you examine it, you will find is a suede-finished fabric. That is a rubberized surface on a cotton sheeting. It happens to be a 4.75 plain-dyed sheeting.

If you will notice on leatherettes there is a variety of embossed effects, some of them in two colors, and some plain.

With regard to next year, we are vitally concerned as to what is going to run out. We don't know exactly what it will be. As I say, leatherettes will probably run. If we can attract the public enough with our embossed or any other surface effects, it may be that leatherette will run longer, but as sure as anything in this business, leatherette has a limited life—I mean a limited life with regard to popularity. The trade is going to get away from it in time, as this business runs in cycles, and we don't know whether the double texture, of which we have a sample here (merely two fabrics combined together), will be the following big number. At the present time, this rubberized suede finish, is very popular. There is a demand for it. On the other hand, it is difficult to make. I don't believe there is a rubberizer who has yet made a perfectly satisfactory material, that is, satisfactory to himself, although several of us have made very nice appearing fabrics. Whether or not this is a practical number is questionable. Personally, I think it is a transition number and may have only a short run in popularity. Nevertheless, it is a possibility.

Chart No. 3 shows single and double textures during 1927 and 1928 by months. The single texture curve is a typical seasonal trend, as there is usually a heavy falling off in November and December. The dotted line of double texture production is significant in its indication of a month by month gain during 1928 over corresponding periods in 1927. Any number which can build up to over three-quarters of a million yards in the month of October is worth watching. It may indicate the next favorite. Just how significant those trends as represented are, we don't know.

Although we are discussing principally the needs of the proofing industry it is well to mention the allied business of rubberized automobile topping. This business is specialized and is of such size that it has seemed desirable to classify it separately from proofing and accordingly it co-operates under its own division of the Rubber Association. It uses chiefly wide (60-inch) fabrics such as drills, sheetings, whipcords, teals, sateens, etc. In 1927 it consumed 13,511,340 lineal yards of fabrics, equivalent to nearly twenty million square yards of fabric. There is a tendency now on the part of the automobile industry to use narrower goods and it looks like most of the 1929 requirements may be for 45-inch finished material. This, of course, represents a loss in yardage to the textile industry, as it does also to the automobile topping manufacturers. Our lineal yardage will remain up but the dollar value of our sales will be less.

You will notice that in practically all the new cars coming out this year the decks, instead of extending way over to the rain trough along the side, are only extending across the top itself and that the metal body panels are running over the sides. Now we have only the 45-inch strip across the top of the car, whereas we formerly produced 63 or 64-inch material that came way down to the sides. This is causing my own company some concern because we manufacture a very substantial amount of auto deck material.

The general requirements for fabrics for this business are similar to those for general proofing, and it is our hope eventually to offer standard specifications for them.

An allied product to rubberized fabrics is pyroxylin

coated material, used for auto topping, upholstery and many special articles. This industry again has problems similar in many respects to ours with regard to fabric requirements. In 1927 pyroxylin coated manufacturers used nearly thirty-three million yards of fabrics and in 1928 will probably consume nearly forty million yards. Other coated textile industries like oil cloth and tarpaulin manufacturers use much material, though we have no figures available regarding them. It is apparent, however, that the textile industry sells a tremendous yardage to the coating manufacturers and that it is highly desirable to know as much as possible about the special requirements of the various groups. It is with this idea in mind that we have the temerity to approach you with this discussion of some of our proofing requirements.

Before I close, it seems desirable to just run over briefly the tentative specification already laid down. It is laid down only for discussion in our own industry at the present time.

We are specifying generally with regard to quality. We want thoroughly clean cotton, and so forth.

On width, we want to specify a definite width, because we must have a tolerance on width, in order to finish our goods, say, 36 inches for the trade to which we sell. It is necessary, therefore, that we have at least 37 inches in our finished fabrics which are to be rubberized.

Specifications for weight and count are no more than you would expect, and also breaking strength, except that we hope eventually to set down average strengths and ask you to guarantee them later.

The matter of length of cuts in fabrics is very important. Frequently we get numerous short pieces in our bales that cause us considerable loss. We want to specify the number of short cuts in a 500-yard bale, and have you willing to stand on that basis by taking back goods that do not come up to that requirement. With finished goods, we would give you a little more allowance on short pieces than on gray goods.

We will enumerate definite defects which we will classify as of major importance. Major defects cause seconds with us and we want them limited. We have here (and they can be passed around) some rubberized fabrics showing major defects in the fabric and the resulting effects on coating.

We want selvedges uniformly made with the same tension as that of the body of the goods, so that we will not get baggy material which will cut when passing through our calenders.

We want the minimum of sizing because for rubberizing we want rag-finished goods.

And, with regard to injurious chemicals, we will specify as mentioned in the discussion.

Fastness of dyeing with regard to bleeding and crocking is very important. In the raincoat industry we are not so much concerned with fastness to sunlight because our finished product does not come in contact with the sun very much, but it must not bleed or crock when wet or we will have a few dresses to pay for, besides coats.

Of course, we want our dyed goods to be fast to perspiration and fast to the temperature conditions of our dry-heat cure; that is, 260° F., and fast to the effect of sulphur chloride fumes. We shouldn't get fading under either of those conditions. This will represent the type of specification that we hope eventually to present to the textile manufacturers. (Applause.)

President Killheffer—Gentlemen, the points brought up in Mr. Byam's paper with regard to specifications are of more immediate interest to our Research Committee than to a gathering of this kind, and I think we will refer the recommended specifications of Mr. Byam to that committee for study of those particular specifications that would come under our sphere of activities.

F. R. McGowan—Mr. President, I wonder if this is not an opportune time, while Mr. Byam is here, to have a discussion of his paper, and perhaps that discussion will help the Research Committee to get the facts.

President Killheffer—It would be a most opportune time to have some discusion, Mr. McGowan, except for the fact that we have considerably overstayed our time and we must get along or we will simply have to crowd a number of papers off our program. So that I think probably the best place for that consideration would be right in the Research Committee, and it is my idea to suggest to the chairman of the Research Committee that he invite Mr. Byam and yourself to meet with them in order that we may have an intimate discussion of those things. In that way we will get further than if we discuss the matter in an open meeting such as this.

Mr. McGowan—That is all right with me if it is all right with Mr. Byam.

President Killheffer—I think we will get better results that way, because the Research Committee meets very frequently, and if we start on this discussion here we won't get nearly so far as we would in a meeting of the Research Committee.

We will now proceed with the business session.

SATURDAY AFTERNOON SESSION

December 8, 1928

THE meeting convened at 1:45 o'clock, Dr. E. H. Killheffer, President, presiding.

President Killheffer—The first paper this afternoon will be the one by Mr. Bray, of Procter & Gamble, "Potash or Soda Soaps—Which?" Mr. Bray! (Applause.)

Potash or Soda Soaps—Which?

By W. W. Bray

Textile Research Department, Procter & Gamble Co.

"W E-E-LL, yes, maybe this soda soap is all right for some kinds of wool, but for real fine work on high-grade worsteds and woolens nothing can equal a good potash soap!"

Although completely lacking in scientific proof, this statement, or the notion at its core, has been accepted with but feeble resistance by many generations of wool manufacturers. Emphasized by the practising scourer or finisher, believed and repeated by the mill manager or owner, echoed even to-day by some technical consultants and authors, the preference for potash soaps has attained almost the proportions of a religious dogma. The creed of the finisher has become an article of faith for the entire woolen industry. And until quite recently to question it was a thing almost unheard of.

But present-day science and industry progress by such questions. They seek to know whether a thing is true, and, if so, why. No beliefs can be accepted merely because they bear the authority of long tradition—no processes can be assumed perfect simply because "it has been done this way for fifty years." Continuous examination of products and processes, with systematic inquiry into their merits, is the most effective way to assure the advancement of any industry.

Naturally, then, there should be critical inspection of any prejudice which supports an expense that is perhaps avoidable. Potash soaps cost considerably more than soda soaps, but do they give results proportionaly better—or even as good? If not, can the mill man afford to continue their use?

What justification is there for the use of potash soap? Is there any truth in the broad statement that potash soap has a milder action than a soda soap on the wool fiber, and so leaves it stronger, softer and more lustrous? If so, let us know definitely how much and why, that we may determine whether the result is worth the price. If not, let us by all means publish the facts so that we may cast aside prejudice and eliminate unnecessary expense.

Having recently completed a program of fundamental research, we find that the preference for potash soap seems to be absolutely without foundation in scientific or practical truth; that for wool processing, soda soap of the correct type is in every way the equal of potash soap of the same class. From another angle, oleic acid having been proven the ideal soap stock for wool treatment, potassium oleate is in no respect superior to sodium oleate.

Origins of the Potash Legend

Why has this time-worn preference for potash soaps been so persistent? Doubtless it began in the days when practically all soap was made with potash. It was only a hundred years or so ago that cheap processes for producing soda alkalies made soda or "hard" soap practical or less expensive than the potash article. Thus the wool scourer in swinging to soap from more disagreeable scouring compounds became accustomed to potash soap. (And a habit so generally acquired as this came to be is hard to break.)

The fact that potash soaps in general are softer as well as more soluble than soda soaps must also have had considerable bearing on the choice of the former. It is natural to look for a certain relation between the properties of the soap as such with the qualities that soap might impart to the treated fiber. The extent to which this is true will be discussed fully a little farther on.

Further confusion and prejudice have arisen from the fact that comparisons were and still are made on a most unfair basis. One often finds a good olive fig soap recommended as superior to soda soaps of grease, cottonseed oil or low-grade oleine base. Naturally! And a good soda olive soap would be just as much better.

From another angle, it is not uncommon to have the wool scourer, after a trial run of soda soap, say in effect: "The wool scoured with this soap is not as soft and lofty as some on which I used a potash soap two weeks ago." Very possibly there might be differences in the natural characteristics of the wools, but they apparently are not taken into account. Or even if the wools were identical in nature, how accurately can any man judge such results by comparison of a sample in hand with what he remembers about one tested two weeks previously? The plain truth is that softness, loftiness and all the properties that go to make up what is known as "feel" or "handle" are such indefinite things that even the most experienced judges find it difficult to agree on the better of two samples when only slight differences between the two are expected.

Again it has often been argued that potash soap should be used on wool because the suint or sheep perspiration carried by raw wool contains a large percentage of potassium compounds. Just where the connection lies it is difficult to see. It would be just as sensible to argue that because raw wool contains lime salts it should be scoured with hard water containing similar lime compounds. The fact is that both lime and potassium salts are present as

impurities. Both make scouring more difficult and interfere with the development of the desirable properties of the fiber.

A phase of this topic which verges actually upon the ridiculous is the use of potash soap for scouring in combination with soda alkalies. Many a mill will assert that its particular finish is dependent on the potash soap, although large proportions of soda ash are added to the scouring liquor. Now, because of the chemical nature of these two substances, soda ash (sodium carbonate) when put in solution with potash soap causes an exchange of alkalies with the formation of a soda soap and potassium carbonate. Of course, the proportion of soda ash used for scouring is far more than that required to make this change in the soap, so what actually results is a solution containing soda soap, a small amount of potassium carbonate and a relatively large amount of sodium carbonate. Under such conditions, it is hard to understand how the potash soap deserves any credit whatsoever for giving fine qualities to the wool.

What Is a Fair Basis of Comparison?

In order to determine the relative value of soda and potash soaps, there must first be established specific points on which a definite comparison can be based. Accordingly, it will be convenient to apply as a measuring stick the set of standards that was established for the determination of the type of soap most efficient for scouring wool. These properties of a soap may be listed as follows:

1. Degree of solubility.
2. Degree of hydrolysis and preferential absorption.
3. Degree of rinsibility.
4. Ability to form a stable fatty acid emulsion on acidification.
5. Stability toward rancidity.

Interpretation of all data available under these headings will furnish enough information to judge the behavior of soda and potash soap solutions and their effects on the wool fiber.

Influence of the Fat or Oil Stock of the Soap

Before discussing the experimental procedure and results, it must be understood that comparisons can be drawn only between soaps of the same fat or oil base. Soda tallow may be matched against potash tallow or soda olive against potash olive, but not an olive against a tallow base, nor a stearate against an oleate. Small yet definite differences may be detected between the soaps of soda and potash containing similar fatty acids, but between soda (or potash) soaps of different fatty acids, even of stocks so closely related as oleic acid and olive oil, a much wider range of properties exists. From the fact that of a given weight of soap the fat or oil portion furnishes about 90%, it is obvious that the alkali (soda or potash) fraction has decidedly a minor influence on the properties of the soap. As a practical example, the difference in the rinsing qualities of potassium and sodium oleates is very hard to distinguish, while between sodium oleate and a soda tallow soap the wide difference is apparent even to casual observation.

In our experimental work on this subject all possibility of error of the sort just described was avoided by using a single oil stock to make both soda and potash soaps for testing purposes. The fatty base selected was a high-grade oleic acid, having a titer of 12° C. Each soap was prepared in the form of thin, lustrous flakes, identical in appearance and each with a real soap content of 94%. Such soaps were chosen in preference to chemically pure sodium and potassium oleates because they are products which can be manufactured under commercial conditions. Hence with their use conditions of plant operation can be closely approximated.

General Outline of Experiments

Something has already been said about the difficulty of making fine distinctions with only the crude means available to large-scale handling of wool. To realize this it is only necessary to try a few experiments and observe the wide variations that will most certainly appear in tests that would be expected to give check results.

In the laboratory, however, conditions can be determined with a reasonable degree of accuracy. In these tests, for example, a worsted yarn was prepared for use by thorough scouring in gasoline and ether. In this way was obtained a perfectly clean yarn bearing no impurities to be reckoned with. Then treatments in soap solutions were devised to obtain the desired effects on the properties of the wool. Definite conditions were established and maintained at all times. Finally, dependence was not placed on human judgment of such things as elasticity, softness and loss in strength. Instead, tests of measurable accuracy were developed for the determination of changes in these qualities.

The results, therefore, are of particular value, since they present probably the first dependable summary of accurate information regarding the relative excellence of soda and potash soaps in their application to wool processing. A detailed discussion of these

experiments and their logical conclusions is given under the headings defined above.

1—Degree of Solubility

It is true that at a given temperature a potash soap is somewhat more soluble than the corresponding soda soap. In the case of high titer soaps, the difference is very marked and doubtless has been one of the main reasons for the prejudice in favor of potash soap. But as the titer is lowered, the solubility of either soap is greatly increased and the apparent margin of difference between the soap and potash article is narrowed. Thus in the oleate, the lower limit of titer, even the soda soap has acquired a degree of solubility in excess of the practical needs of textile processes. For example, its solutions in concentrations as high as 25% or 30% remain liquid at room temperature. It may, then, be said that sodium oleate is so readily and so highly soluble that a greater degree of solubility is unnecessary and would have no particular advantage.

Recent advances in soap manufacture have made great changes in the ease and rapidity with which soap can be dissolved. A low titer (12°) soda soap can now be made in a thin, dry flake, and so holds a tremendous advantage over potash soap, available only as a stiff jelly which goes into solution very slowly. Practical trials have shown that the flakes can be dissolved in one-half the time needed by the potash soap jell, with consequent savings in labor and steam.

Closely associated with the solubility of a soap is its ability to absorb and hold moisture under varying atmospheric conditions. Comparing the soda and potash soaps as flakes, the latter, on exposure to damp air, will pick up water very rapidly and soon reach a sticky, jelly-like consistency. The former will take up considerable moisture but with less apparent physical change.

It was thought for some time that this property of potash soap might actually prove of benefit to wool. Since more or less soap remains in wool after a scour, it seemed that if this soap were potash, it might retain more moisture, which would increase the apparent softness of the fiber.

To learn the truth of this, clean, air-dried wool flannel squares were weighed, soaked at 130° in 0.3% solutions of the two soaps, again air-dried and weighed.

The results conclusively disproved this theory. Measurement of the regain after soaking and drying, instead of showing a higher figure for the sample soaked in potash soap, demonstrated that the soda soap is fully as effective, if not more so, in this regard. Typical regain figures are given below:

Sample soaked in	*Moisture Regain*
Distilled water	11.3%
Potash soap solution	12.1%
Soda soap solution	12.3%

In comparison with a really low titer soda soap all the alleged superiority of the potash type in respect to solubility completely disappears. Such advantages as may have existed before the introduction of commercial sodium oleate are overcome by the latter soap. Consequently, on the score of solubility, there remains absolutely no argument in favor of potash soap.

2—Degree of Hydrolysis and Preferential Absorption

Potash soaps have been claimed to be "milder" than soda soaps in their action on the wool fiber. At the same time, no definite proof has been advanced to support this statement, nor has there existed more than a vague idea as to its meaning. Such terms as "softness," "springiness" and "loftiness" have become footballs to be passed back and forth in discussion, without their meanings being clearly understood.

The basic desirable qualities of the wool fiber are: (1) Softness; (2) elasticity—loftiness; (3) strength. To say one soap is milder than another means that it has less harmful effect upon the above qualities. A comparative judgment between two soaps, then, must include relative measurements of their effects on each of these properties of wool.

It is, of course, well understood that the action of soap solutions on wool is the chemical combination between the wool substance and the alkali liberated by hydrolysis of the soap. This reaction has been termed "preferential absorption" because the alkaline portion of the soap is absorbed by the wool, leaving the fatty acid free either in the bath, or deposited on the fiber. Other factors being equal, its extent is entirely controlled by the degree to which a given soap hydrolyzes. That is, a highly hydrolyzed soap yields a greater concentration of free alkali, which in turn reacts more completely with the wool.

By simple tests, the effects of an alkali on wool can easily be demonstrated. Softness can be changed to harshness. Elasticity can be converted to plasticity, as is partially and more or less temporarily done in fulling. From a lively or springy material it can be reduced to a dead, sodden mass. Its strength can be sapped until, in solutions of caustic alkalies, the wool

is completely dissolved. At a given temperature, the rate and amount of these changes are proportional to the strength and concentration of the alkali used.

Since this is true, a very convenient way of judging the effect of a certain soap on the softness, elasticity and strength of wool is by measurement of the concentration of free alkalinity in a solution of that soap. This can be done in two ways: by determining (a) the degree of hydrolysis, or (b) the degree of preferential absorption. Direct estimation of the softness and elasticity, i. e., handle, is well nigh impossible—hydrolysis and absorption measurements can be made with far greater precision. Accordingly, such means were chosen for determination of the relative effects of sodium and potassium oleates on wool fibers.

(*a*) *The Hydrolysis of Sodium and Potassium Soaps.*—Measurement of a soap's hydrolysis, i. e., of the concentration of sodium hydroxide resulting from reaction of the soap with water, is a very difficult determination. Although the alkalinity thus released is an extremely important factor in the behavor of a soap solution, its amount is very small. Delicate methods of procedure are necessary. Moreover, numerous sources of error must be avoided.

The most careful and extensive determinations of this sort have been made on sodium and potassium soaps by Dr. J. W. McBain of the University of Bristol, England.* His results are quoted here because they illustrate so completely the present point.

McBain has found that the hydrolysis of potassium soaps is slightly but uniformly greater than that of sodium soaps. Pure potassium palmitate in approximately 0.3% solution at 90° C. is hydrolyzed 6.8%; sodium palmitate, 6.6%. In more concentrated solutions, 2.75% soap, the hydrolysis is lower but in the same relation—potassium palmitate, 1.25%, sodium palmitate, 1%. Other experiments show that similar relations exist between solutions of the two oleates. This, and the evidence of still other investigators, establish conclusively that the potash soaps are the more highly hydrolyzed.

(*b*) *The Preferential Absorption of Sodium and Potassium Soaps.*—The absorption of the alkaline fraction of a soap naturally depends on the concentration of available alkali liberated in solution. In other words, preferential absorption is directly proportional to hydrolysis. However, it was thought advisable to make separate determinations of this factor, because it is a test that can be made on the wool after treatment under conditions practically identical with those of a plant process.

*See Jour. Chem. Soc., 105 (1914), 957, and 115 (1919), 1279

Clean skeins of the wool previously described were soaked for one hour at 130° F. in 0.3% solutions of the specially prepared soda and potash soaps, during which time absorption of alkali from the solution took place. The skeins were then lifted out and centrifuged to remove excess liquor which was returned to the soaking baths. These liquors, which had now become opaque from the deposition of fatty acids (or more accurately acid soaps) were titrated with a standard acid to determine the total alkali remaining after the soak. A fresh soap bath of the same concentration was likewise titrated to learn the amount of alkalinity present at the beginning. From these figures the per cent of alkali remaining could be calculated.

Corresponding to its lower hydrolysis, the soda soap permitted less absorption of its alkali by the wool. Averages of several tests showed that 12.7% of the original alkalinity was lost by the soda soap while 14% was absorbed from the potash soap solution. When the difference, 1.3% of the original, is figured as a percentage of the amount absorbed, it is seen that the wool takes up about 10% more alkalinity from a potash soap solution than from one of soda soap.

These hydrolysis and absorption figures are extremely important, since they demonstrate conclusively that soda soap is actually milder in action on wool than potash soap. The alkali released in hydrolysis is the damaging agent. The soda soap hydrolyzes less, and therefore works less injury to the softness, elasticity and strength of the wool fiber.

3—Degree of Rinsibility

Probably no single feature in the performance of a soap on wool is of greater importance than the ability to rinse quickly and completely. In a study of this operation, several factors must be considered, each of which has an important influence on the result. Solubility is closely related to rinsibility, because soap is most cheaply removed in water solution. Absorption of soap by the wool fiber increases the resistance to extraction with water. Moreover, the reaction between the wool and the alkaline portion of the soap liberates fatty acid, part of which adheres to the yarn or fibers.

After determination of the preferential absorption as just discussed, the soaked skeins were given one rinse in thirty times their weight of distilled water at 120° for ten minutes. Excess liquor in the skeins was removed by centrifuging and returned to the rinse baths. The rinse liquors were then titrated with standard acid to determine the alkalinity (as soap) removed, and this quantity was calculated to a percentage of the total amount retained by the wool after soaking.

These tests, repeatedly checked, failed to show the slightest superiority of potash soap in rinsing. In fact,

the averages of several determinations proved that the soda soap rinsed, if anything, a trifle more completely. In actual figures, under these particular conditions, 32% of the alkalinity absorbed by the wool from the soda soap solution was rinsed out, as against 29% of the potash. The combination of lower absorption with greater removal on rinsing speaks forcefully in favor of this soda soap and absolutely destroys all claim to superiority on the part of the potash soap.

4—Ability to Form a Stable Fatty Acid Emulsion on Acidification

On account of the many processes subsequent to scouring which involve the use of acids, it is most important that the fatty acids from the decomposed residual soap remain dispersed in a permanent emulsion instead of gathering into drops which may adhere and cause trouble. Since the soap is decomposed and the alkaline portion (soda or potash) removed from the field of action, it is obvious that the single controlling element is the type of fat or oil from which the soap is made. Hence the sodium and potassium oleates are equal in this respect and both furnish very stable fatty acid emulsions.

5—Stability Toward Rancidity

For the purposes of this test, open containers of the soda and potash oleate flakes prepared for these experiments were kept in the laboratory in an atmosphere of a humidity somewhat higher than normal. After standing about three months, the potash flakes had acquired a decidedly rancid odor, and at six months rancidity was highly developed. A jellied potash soap, similar to the commonly marketed form, turned very rancid even earlier than the flakes. The soda soap, on the other hand, at the end of the six months' period possessed not the slightest taint of this kind and remained apparently as free from rancidity as the day it was stored. This ability of a soda soap, even of so low a titer, to retain its original freshness is a very positive advantage over the potash product.

Conclusion

From the foregoing data and discussion we may draw the following conclusions:

(A) Claims for the superiority of potash soaps rest on tradition and prejudice rather than on scientific proof. Rule of thumb methods of operation have tended to keep alive the preference for "fig" soaps. The difficulty of making accurate comparisons and eliminating unfair judgments has discouraged many attempts to replace them with good soda soap. Suitable methods had to be developed to furnish means for determining the relative merits of the two soaps.

(B) Sodium oleate has been shown to be at least equal and in many respects decidedly superior to potassium oleate. The low titer of the soap stock provides definite advantages which overcome and surpass the doubtful benefits imparted by potash. For a quick survey, a summary of the results of the comparison is presented below:

1—*Solubility:*

(a) Sodium oleate is so highly soluble that it exceeds any textile demand.

(b) Its flaked form makes it far more rapidly soluble than potash jell.

(c) Moisture absorption properties of the two when on wool are equal.

2—*Hydrolysis and Preferential Absorptions:*

(a) Soda soap hydrolyzes less, and loses less alkali through absorption by wool.

(b) As a result, it has a less harmful effect on the softness, elasticity and strength of wool.

3—*Rinsibility:*

The soda soap rinses even better than the potash, due to its approximately equal solubility and lesser absorption.

4—*Stability of Fatty Acid Emulsion:*

This is of a high order and equal for both soaps, since it is entirely dependent on the low titer of the oil stock.

5—*Rancidity:*

Potash soap, both in flake and jell form, becomes rancid in a short time, while the soda soap remains stable for a long period.

(C) There remains, then, no sound reason for the continued use of potash soaps for processing wool. It appears that the industry can satisfactorily and profitably employ low-titer soda soaps, produce an even finer quality of product than in the past, and reduce operating costs materially by saving the premium of 10% to 15% paid for potash soaps.

President Killheffer—This afternoon we are going to try to make up the time that we lost this morning. I am afraid, on this particular paper, we will be compelled to pass up the discussion period unless someone has something that he thinks is of paramount importance. And in the papers that follow the time allotment must be strictly adhered to. I shall therefore take the liberty, as I did in the case of Mr. Bray, of calling attention of the speaker when he is within two minutes of the expiration of his time, because that is the only possible way that we can prevent the crowding of someone off the program.

The paper next to be presented is one by M. L.

Griffin, on "Dewatering and Drying in Some Manufacturing Processes." Mr. Griffin will have fifteen minutes for the presentation of his paper, and then there will be five minutes for discussion.

Dewatering and Drying in Some Manufacturing Processes

By Martin L. Griffin

IN casting about for a subject that I trust will be instructive, or at least suggestive of ways and means for effecting important economies in processing textiles, as well as preserving some of their natural characteristics, I fail to observe that the subject of the removal of water has received the attention it deserves. It is generally recognized by industrialists that with the enormous increase in production due to the greater capacity of the individual units and automatic means of control, thus relatively requiring less manual labor, two problems of paramount importance are developing. One is the competition for markets, the other unemployment of labor. To meet the first of these we must scrutinize our processes to discover how we can reduce costs, improve products and eliminate waste.

The textile industry is one of the oldest, and for various reasons has been much depressed throughout the world. While it is basic, it offers great possibilities for originality in display and specialization. I do not feel that the managing personnel has kept pace with modern scientific methods, developed by research, in other lines. The builders of equipment and the process routine, especially in finishing, often leave much to be desired. The removal of water and moisture in the various processes of manufacture and finishing is such a common matter that, doubtless for this reason, its importance has been overlooked. On the other hand, the preservation of the natural conditions of humidity in textiles is more important than we realize.

Bleaching and finishing require many successive treatments in which water plays one of the major parts. In passing from one stage to another a large part, if not all, must be removed to prepare for the next stage of the process. Squeeze rolls and dry cans are the elemental means for doing this. In the case of the former, I might say almost no research has been done to improve conditions. Builders and users of equipment have been content to specify materials and sizes of the rolls, and their operation has been given no particular further concern. The importance of maintaining a true and smooth surface throughout the length of the rolls and a uniform pressure are prime necessities for good results. Whether the product is to be only partially dewatered or fully dried in passing to its succeeding stage, the importance of removing the maximum quantity of water uniformly should be quite obvious. Due to great variations and uncertainty many operators prefer to run the product over the cans, completely removing all water. This, however, adds a considerable item of cost and should be avoided.

Now, there are two major operations in cotton textile finishing in which, if more systematic and dependable results could be had, this would not be necessary. I refer to the preparation of the cloth for mercerizing and machine dyeing. If there were a greater co-operative effort made to squeeze to the same degree of water content, or an adjusted content, in these two adjacent stages, many annoyances would be obviated, and the expense of drying between would be saved to those who have felt that complete drying was the only safe procedure.

The function of squeeze rolls in a process range varies according to the object sought. In the case of saturating in the mercerizing pad, particular attention should be paid to the final "nip," that it squeezes out uniformly as much of the excess caustic as possible, as this is a direct saving of the high concentration caustic; whereas otherwise such avoidable excess passes to the washings, entailing waste and expense. In the dyeing range, the importance of perfectly surfaced rolls carrying uniform pressure from end to end is essential if satisfactory work is to be expected. No matter how well the goods may be bottomed, perfect work cannot be had if the rolls are not in the best condition possible.

Research in Connection with Squeezing

There are several research problems connected with dewatering by means of squeeze rolls which should be taken up by this industry, collectively if not individually. I may enumerate some of them as I think of them.

First—The materials of construction. In the case of rubber-covered rolls, the best composition and degree of plasticity. On this particular phase of the problem the B. F. Goodrich Company has done considerable work.

Second—Given rubber-covered rolls of the same diameter but of different degrees of plasticity, which, the harder or softer, will express the more water, all other conditions remaining the same? This perhaps is a corollary to the problem which of two sets of rolls, the one of larger or the other of smaller junction contact, will remove the greater amount of water, otherwise under similar conditions.

Third—A series of experiments is needed on the work performed by a set of squeeze rolls under varying pressures; also a series of experiments using sets of rolls of different diameters at the same pressure.

Fourth—The effect of temperature in expressing water. The viscosity of water at ordinary temperatures decreases about 2% for each degree rise in its temperature. Therefore, heating 25° would halve the viscosity and make more effective the squeezing process.

Fifth—Under what condition of water content in squeezing cloth is "fraying" liable to take place, if you agree with me that this has anything to do with the cause of fraying? If so, what is the remedy?

Sixth—I am in doubt as to the relative value of a three-roll high pad compared with a two-roll single nip, or as with two two-roll pads in horizontal range for the removal of water, other things being equal.

Perhaps you will pardon me for making reference to the results of some research on improvements in expressing water from the continuous web of paper during formation. It will, at least, be interesting, and may possibly find application to textiles.

In the matter of water removal by means of filter and hydraulic presses, it is customary to use metallic or fibrous matting to provide channels for the escape of the water. The problem was to transfer the idea and its application from a static to a continuous moving process, such as is presented in removing water by means of squeeze rolls. In the first instance, rolls were wound throughout their length with wire, spacing the convolutions. This experiment proved the correctness of the idea, but was not a success from a mechanical standpoint. The next step was to groove the surface of the rolls, which proved very satisfactory, and it is possible to remove water to an extent not possible with ordinary plain rolls. The shape of the grooves is very important and must be designed to meet the conditions in question. The best results are obtained by a succession of two rolls which progressively remove water up to a 50% dry basis.

Some of the Principles of Machine Drying

In preparing the work for drying it is also important to deliver the goods with some uniform content of moisture, and this cannot be done by squeezing in rope form, otherwise there will be under or over drying in part which will preclude anything like automatic control and uniform conditioning, which are now recognized as very important in process work.

The problem of drying, in general, consists in the removal of water existing as liquid by a change in its state of aggregation, to a vapor and the removal of the vapor. The tendency of all liquids is to pass into the vapor phase. The pressure at which a liquid and its vapor are in equilibrium is called the vapor pressure of the liquid. As long as these remain in equilibrium there can be no evaporation. The problem, then, is to prevent this condition by dispersion or condensation of the vapor, and with this dispersion or condensation continuous evaporation will take place.

At any temperature, when a liquid as water passes to a vapor or gaseous condition there is a large absorption of latent heat. When this takes place at or below the normal temperature and pressure of the atmosphere, the vapor must be removed by some positive means to cause evaporation or drying. That is, the vapor pressure must be continually reduced in a continuous process. Ordinarily this is accomplished by means of circulating air currents. A good illustration of both phenomena is the power-plant spray cooling pond, where cooling takes place by the evaporation of a small fraction of the water and its removal by currents of air, continually reducing the surrounding vapor pressure. If these currents of air are partially occupied by moisture already, their capacity to carry additional moisture will be reduced, and to accomplish equal results greater volumes or higher temperatures will be necessary. On the other hand, where evaporation takes place above the critical density the vapor will assume the form of a gas under pressure and may be condensed to a liquid and thus removed.

Three Sets of Conditions

There are three different sets of conditions under which evaporation or drying may be conducted. First, there is air drying, where the forming vapors are dissipated by means of currents of air; second, drying at elevated temperatures within an enclosed space, whereby the vapors force themselves out and may be condensed for recovery of their heat values; third, drying in vacuum chambers with the removal of the vapors by means of a vacuum pump and condensing for heat recovery. Of these three methods, the first is most commonly employed in the great industries of textile finishing and paper manufacture.

Development of Drying Processes

The original and primitive modes of drying consisted in exposing the materials to be dried to the atmosphere. In pleasant weather no better way could be devised to preserve the natural qualities, but such slow and uncertain methods cannot adapt themselves to modern industrial conditions and they have given way to more favorable conditions where all the factors are under complete control. The instruments used in the textile industry are the drying cans and the tenter frame, with their necessary auxiliaries. Too frequently these machines have been set up in buildings with no consideration for doing efficient work and no special provision for the disposition of the moisture, with the result that drying often becomes a matter of more cans added to the range, or increasing steam pressures, leaving the moisture to take care of itself, with the result that the building becomes filled with hot saturated vapors condensing on walls and ceilings, risking damage to the work and trying conditions to the operatives, to say nothing of the increased cost of maintenance for buildings and equipment. In the designing of all in-

dustrial plants for any purpose whatever, heating and ventilating engineering should occupy a very prominent place.

The Application of Steam and Air to the Drying Range

Low-pressure steam should invariably be used for several reasons: The cans are not built to carry high pressures; the greater part of the available heat is latent and must condense to perform work; the demand for high-pressure steam indicates, in the first place, a lack of capacity in the lines to carry the volume of steam required at low pressure. Other reasons may lie in excessive amount of moisture in the cloth coming on, as well as faulty disposition of the moisture. The cans provide one of the best avenues for heat recovery in low-pressure exhaust engines. The steam headers should be of ample capacity, and if the range is long it may be desirable to divide it into two sections. Formerly it was customary to depend upon the pressure to evacuate the condensate through traps. This method always involves many uncertainties and often waste. It is much better practice to take away the condensate by means of a pump which will discharge it to a useful destination. It is very important to know that every single can is taking steam freely and evacuating its water and air constantly. There should be no misapprehension as to the inefficiency of a water-logged can, even though it were to register the temperature of the steam.

On the air side of the problem the course of progress is of the following order. First, the installation of fans to discharge more effectively the vapors from the building, and the use of steam coils against the roof where condensation caused trouble. Following this, air-heating units were installed to deliver warm air to the building. These matters had to do solely with conditions in the room where the process was carried on, and had nothing to do, except incidentally, with efficiency in drying. Hoods were more or less used to confine the vapors. These of themselves contributed to better conditions in the room, but little or nothing to the capacity of the system until provision was made for a rapid sweeping away of the saturated vapors.

In passing a wet web over a set of drying drums it will be observed that the web forms pockets, which prevent the rapid egress of the vapors, and that this pocketing takes place to a greater degree in the vertical stack than in the horizontal range. It is now common practice to place the most efficient hood over the set and to conduct warm air, by means of spray nozzles, into these pockets and continually sweep away these vapors, leading them to an exit stack.

Since the capacity of the air per unit volume depends upon its temperature and relative humidity, it becomes of prime importance to estimate in advance the average amount of moisture to be evacuated in the process and to adapt the equipment to this requirement. Since the humidity of the atmosphere is variable, it will be necessary to provide for variable volumes and temperatures of fresh air entering the system to perform a constant rate of work. As a part of such a system, means should be provided for controlling the air supply, the basis of which is the wet and dry bulb thermometers. This may be automatic, and complete saturation of the exhaust vapors is now possible, thus insuring the maximum efficiency in the use of air. This does not mean that the capacity of the equipment is necessarily increased, but it does signify that the steam consumption will be less, with all that this implies.

Heat Recovery

In my discussion of the problem up to this point I have considered outside air under its varying conditions of temperature and humidity and the discharge of the moisture-laden vapors to the atmosphere with a total loss of its heat content. In recent years successful means have been developed for recovering a large proportion of this heat by passing the exhaust vapors through air-cooled heat exchangers. The fresh air thus warmed to more constant conditions furnishes the new supply for the work, with the resulting saving in the use of steam and much improved working conditions. I should add that such a system is more profitable where operating conditions are reasonably constant and on a moderately large scale. Small units and irregular conditions of operation would not be worth while.

The second and third methods of drying within enclosed chambers are to an extent much alike in principle, the former operating at pressures slightly above atmospheric, while the latter is designed to run under a high vacuum. This difference, however, has important consequences. The second method was developed experimentally by John E. Alexander at the Armour Institute of Technology in Chicago, with the able assistance of Stephen A. Staege, general engineer of the Westinghouse Electric & Manufacturing Company. Designed to operate at approximately atmospheric pressure, no special features in designing the chamber were necessary. The web entered the chamber and passed out through narrow slots, and the vapors escaped under their own pressure through suitable ducts to condensers. Electrical resistor units furnished the source of heat.

The third method was worked out by Ogden Minton, a distinguished engineer and inventor, who was recently awarded a gold medal for this practical achievement. In this case, where the work is done in a chamber under

conditions of a high vacuum, several problems had to be worked out. The chamber must be constructed to stand the external atmospheric pressure, and the web of fabric or paper, or the like, must enter and pass out through effective seals. This proved the crux of the main problem. After much experimenting Mr. Minton succeeded, by designing a seal composed of three rolls closely fitted into their housings whose ends were sealed against the admission of air by rubber gaskets lubricated with a trickling stream of water. It is here that the genius of the inventor is displayed, otherwise the machine is no more than the housing of a set of drying cans, to be operated under a vacuum with its necessary auxiliaries.

Thermal Considerations

Let us make a comparison of the theoretical B.t.u. necessary to evaporate 1 pound of water by each of these three sets of conditions, assuming the same conditions of moisture content and temperature in the drying of either cloth or paper—namely, 70% moisture and 30% substance, and at a temperature of 65° F. For the purpose of illustration we will take a steam pressure of 5.3 pounds whose temperature will be 228°.

	Case 1	Case 2	Case 3
Average evaporating temperature.	183°	212°	100°
Temperature of work entering...	65°	65°	65°
Difference in sensible heat.....	118°	147°	35°
Latent heat	986°	966°	1,044°
Total B.t.u. .....1,104°		1,113°	1,079°

Thus it will be apparent that, so far as theoretical considerations are concerned, there is little economy in the conversion of 1 pound of water into a vapor under the three sets of conditions stated. Wherein, therefore, lies the advantages of one method over the others?

Let us calculate as far as we can the thermal efficiencies of each case. In the first instance we must deal with large volumes of air under varying conditions of temperature and humidity as a vehicle for the disposal of the vapors. The amount of heat which this will absorb will depend upon various factors, such as initial temperature and relative humidity, and final temperature and degree of saturation as the vapors leave the system. This may require 15% or 20% additional heat. Add to this the losses due to radiation, and we have a thermal efficiency in the neighborhood of 50% for the entire system. I have already noted that where drying operations are conducted on a fairly large scale and continuously, the recovery of heat through air-cooled heat exchangers, very considerable economy in steam consumption is possible. Improvements in thermal efficiency and capacity in systems depending upon air for the removal of the vapors will consist in carefully planned hoods and such distribution of the air as will effectively sweep away the vapors at a high degree of saturation. This is always practicable, and under favorable conditions heat recovery should be carefully considered.

Where drying is conducted in a closed chamber at approximately atmospheric pressure, excluding air, the low-pressure vapors may be condensed to heat water; or if the system is operated in such a way as to deliver the vapors under 2 or 3 pounds' pressure, a more extended application can be made of them. If instead of steam-heated revolving drums for the transmission of heat, we employ electrical resistor units delivering radiant energy, we may view the drier, in a way, functioning as an electric boiler. With adequate protection against radiation, the thermal efficiency would be high.

In the third case the essential difference would relate to the application of heat under the influence of a high vacuum of 28 inches. The initial source of heat would be at 228°, while evaporation would take place at 100°, and the vapors would require a pump for their removal. These minimum low-pressure vapors would still possess the same high content of latent heat which would still be available for useful purposes. The possibility of radiation losses at this low temperature would be reduced to a minimum. The thermal efficiency would be very high.

Rate of Heat Transmission

The rate of heat transmission, as you know, depends upon the temperature difference, and this reflects the capacities to a large extent in these three systems. In each the initial steam has a temperature of 228° while the temperatures of evaporation are as follows: 183, 212 and 100° respectively. Therefore the temperature differences will be 45, 16 and 128° respectively. Thus it will be apparent that evaporation *in vacuuo* will require less than half the heating surface required where air is used, and only one-eighth that required under the conditions stated in case two. The most obvious advantage of these closed systems of drying is the fact that the moist vapors are closely confined and cannot migrate about the buildings to their detriment and to uncomfortable working conditions, and heat recovery becomes a very simple problem.

Controlling Devices

Finally I wish to bring to your attention and to emphasize the importance of controlling devices, many of which may be automatic and recording for this kind of work. These rest fundamentally upon the use of wet and dry bulb thermometry. Rather recently, the principles of radio telegraphy have been applied to commer-

cial control for weighing and indicating moisture conditions in continuous web processing. The principle underlying weighing depends upon the fact that the capacity of an electrical condenser, such as is used in radio apparatus, varies with the slightest change in the amount of material between the plates. The material in continuous form passes between the plates with no contact whatever and a continuous record is made.

The principle underlying the indication of moisture depends upon a moisture-sensitive ribbon, stretched in a shielded recess in the bottom of the instrument and so placed that it remains always a small fixed distance away from the material being measured. The ribbon is directly responsive to the moisture content of the manufactured material passing under it, and to nothing else. This instrument is capable of transmitting variations in the hygroscopic element to recording instruments and automatic controlling mechanism. At the present time these inventions have been adapted to the rubber and paper industries, where they are giving very satisfactory results.

Since some experimental work must be carried on to adapt these new discoveries to each particular line of industry, the Atlantic Precision Instrument Company, of Boston, has not as yet offered its services to the textile industry, but expects to as their application develops. Finally, it is generally recognized now that industrial fibers, of which the greatest class is cellulosic, exhibit their best qualities under normal conditions of atmospheric humidity and it is to these that improved methods of drying and conditioning have been developing.

President Killheffer—The next item on the program is a paper by W. H. Cotton on "Application of Indigosols in Printing." (Applause.)

Application of Indigosols in Printing

By W. H. Cotton
General Dyestuff Corporation

GENTLEMEN, for many years the dyestuff manufacturers have been trying to put on the market vat colors in a soluble state but until the Indigosols first appeared, a few years ago, this problem was not solved.

What are Indigosols? Indigosols are leuco-compounds of vat colors. That is to say, they are vat colors in a reduced and water soluble form; and at the same time they are stable, and that is very important, because there would be no use putting a vat color in a reduced state on the market if it was not in a stable form. I do not think there is any other group of colors which can be used for so many various purposes as the Indigosols, and I also think that perhaps they have not been given the attention in this country which they really deserve. I shall therefore in the very short time at my disposal this afternoon try to give you some idea of the manifold methods and processes for which the Indigosols are suitable in printing.

First of all, I should like to state that the Indigosols have the same fastness properties as the vat colors from which they have been formed, but the Indigosols are brighter than the corresponding vat colors because during the manufacture of the Indigosols the vat colors themselves are purified.

When we wish to produce a vat color from an Indigosol we can only do that by an oxidation process, and therefore all methods of applying Indigosols on textiles are based on an oxidation process. We must be a little careful in this respect, for you all know that some vat colors, such as Indigo, can be destroyed by oxidizing agents. You can discharge Indigo with chromic acid or chlorate. Therefore, when you use the Indigosols you must be careful to oxidize the Indigosol only as far as the vat color, but not to oxidize it still further and perhaps partially destroy it. For that reason, it is impossible to give out any definite formulae for the use of Indigosols which are applicable for all local conditions. Every mill which is using Indigosols will have to vary the formulae a little bit in order to suit its requirements.

Gentlemen, Indigosols can be used in application printing, but I do not think, personally, that this is their greatest field. Indigosols should be used chiefly for other purposes, but they can also be printed.

Four Printing Methods

For application printing we have four methods which are being recommended at the present moment: the chlorate method; the nitrite method; the cromate method, and the iron chloride method. They are all four oxidizing methods. I do not intend to mention the iron chloride method any more, because it is hardly ever used, owing to the chloride of iron making the Indigosols rather dull.

The chlorate method is exactly the same as is used for Aniline Black and which you have used for many years for Aniline Black. Besides the Indigosols, you have in the color a chlorate, a carrier of oxygen, and some substance which gives an acid reaction on steaming, such as oxalate or sulphocyanide of ammonium.

By the nitrite method, the Indigosol is printed with nitrite and then developed in acid, and it is a very curious thing which I cannot explain that after printing the Indigosols with nitrite, if you steam the goods, you will get considerably darker shades than if you

don't steam them. I haven't heard an explanation for that.

The same thing is true with the chromate method. If you print an Indigosol with chromate and develop it in sulphuric acid, you will get a better result if you steam the goods before hand.

Gentlemen, you may ask, "Why and in what cases shall we print an Indigosol? They are much too expensive to print."

I should just like to call your attention to the following facts: A dark shade printed with Indigosols is considerably more expensive than a dark shade printed with a vat color and you all know there is no difficulty now in printing vat colors. But when you start reducing those colors you will find a difference. The cost for reducing a vat color with rongalite, potash, glycerine and so on, is greater than the cost of reducing an Indigosol, so that the difference in cost becomes less when light printed shades are compared.

I should like to call your attention also to the fact that Indigosol colors are acid printing colors and you are often able to print them in combination with Aniline Black, whereas printing Aniline Black with vat colors isn't always quite easy.

Furthermore, Indigosols are water soluble colors. In printing Indigosols no ingredient of a hydroscopic nature, such as caustic soda or potash, is required. Therefore, you get the sharpest prints. I should like to show you an Indigosol print that I got from a large Alsatian works showing most beautiful stipple effects. It is one of the finest engravings I have ever seen. I think this pattern is best printed with a water soluble Indigosol. I do not intend to pass these patterns around, because if I do that the attention of the gentlemen will be diverted, but if anyone should like to see the patterns afterwards I shall be most willing to show them. For the present moment I will lay them here. If you try to print that pattern with Indigo you will never get that fine stipple effect that you can get with a water soluble Indigosol.

Another thing in machine printing where the Indigosols are of interest is in combination with Rapid Fast colors. In the range of Rapid Fast colors, as you know, we have at the present moment no good blue; we have no good green; we have no violet. You can combine Indigosols with Rapid Fast colors and therefore get a much larger series of shades. By combining Rapidogene with Indigosol O_4B, you can get lovely greens. By combining Rapid Fast Bordeaux with Indigosol O_4B, you get your violets, and so on. So that the range of Rapid Fast colors can be increased and a complete range can be obtained by supplementing the Rapid Fast colors with combinations of Rapid Fast colors and Indigosols.

Block Printing

Then I should like to mention an advantage that Indigosols have in block printing and stencil work. I know there is not so much block printing done in this country, but in Europe the block printers are sometimes obliged to work a couple of days, even three days, on the most complicated patterns on a piece 60 or 100 yards long. If they have been printing pieces with vat colors they will find in the end that they can't fix their vat colors because the Rongalite which they printed two days ahead has deteriorated in the warm atmosphere of the printing room. With Indigosols you can print the cloth and keep it as long as you like before developing without any deterioration of color.

The same thing is true with all stencil work. I have a few patterns here showing these styles.

I should like to mention one other thing and that is yarn printing. In Europe they have a great deal of difficulty in printing vats on yarn, not on warps, but on yarn skeins, because it is very difficult to steam those yarns in an absolutely air-free ager. The yarn printer can't pass his skeins through an ager. He has to steam them in a box and it is very difficult to get that box free from air. With Indigosols that is a very simple thing. They don't require any steaming at all, if they use the nitrite process, and even if they use the chlorate process it is not necessary to steam free from air, and one will obtain the result of a fast color on yarn, which it has been most difficult to obtain heretofore.

But, gentlemen, I myself think that one of the far more interesting things (more so than the question of application printing) is the use of Indigosols in discharge and resist work. Indigosols are very easy to resist. You can resist them with acetate of soda, with thiosulphate, or with rongalite, and the result is that you can print the Indigosols on white cloth and cover print them with vat colors and get the most splendid effects.

It is also quite easy to resist padded Indigosols. Suppose you pad an Indigosol and then print a vat color on. You don't even need to raise the rongalite quantity in your vat color. The ordinary vat color printing pastes discharge your Indigosol and you get the most beautiful effects, which it is hard to obtain in any other way.

I should like to show you some very pretty work done in Germany along this line. These are Indigosol O resisted according to this method and printed by

the firm of Elbers in Hagen. They are some of the best prints I have ever seen.

Similarly, if you take the Indigosol O4B, which is the Indigosol of the Tetrabrome Indigo, you get these light blue grounds with beautiful resists.

But it is not only vat colors that you can use for resisting Indigosols. One gets splendid results also using insoluble azo colors, Rapid Fast colors, or nitrosamines. Here is a fine piece of work that I brought from Bohemia. In this case the Indigosol O4B has been resisted with a nitrosamine of paranitro-orthoanisidine. You see this lovely red effect on this light blue, and I doubt whether it is possible to get this rich shade of blue and red in any other manner.

Chocolates with Indigosols

Talking about Bohemia, there is another style that has been running there lately and which has interested the printer a great deal and that is the production of chocolates with Indigosol. How is that done? They are doing that in a similar manner to the old process of Henri Schmid, which used to be done on Aniline Blacks. They take a Para Red dyeing and they pad it with a weak solution of Indigosol O and, of course, the Indigosol solution with the Para Red gives a chocolate. If you print onto that chocolate a thiosulphate, the result is that you resist the Indigosol but don't discharge the Para Red. Therefore, the red effect in this chocolate is obtained by the thiosulphate being printed on this prepare. If you print a rongalite on, you discharge the Para Red and resist the Indigosol at the same time. Therefore, the white effects are rongalite, the red is Para Red, and the other effects are vat color discharges.

Now I come to a thing which has interested me personally from a chemical standpoint. It is possible to use Indigosols as resists under Aniline Black. If you told a chemist, to start with, that it was possible to resist Aniline Black with Indigosols, he would shake his head, as I did myself, because you have to oxidize Aniline Black on the fiber. Indigosols you also have to oxidize on the fiber. How is it possible, therefore, to resist Aniline Black with an Indigosol? The explanation of it is this: The Indigosol can be more easily oxidized to the vat color than aniline salt to Aniline Black. The result is, if you pad the goods in Aniline Black and you print an Indigosol on it without chlorate, the Indigosol will take the chlorate away from the Aniline Black, and will be developed to the vat color, and on those spots the Aniline Black cannot be developed. The result is that you can obtain with Indigosols colored resists of great beauty under Aniline Black.

What is the advantage or disadvantage, compared with other vat colors that you could use as Aniline Black resists? The advantage is that the Indigosols are acid colors and the vat colors are alkaline colors and Aniline Black is very sensitive, as you know, to alkalies. If you are not careful you are likely to get halos and scumming on the roller, which is impossible with the Indigosols, because they are acid colors and do not affect the Aniline Black.

I have here some work which I brought from a large German print works. These are Indigosols on Aniline Black. At the time I received these patterns there was not such a large range of Indigosols on the market as there is at the present moment. At the present time you could practically imitate any shade you want as a resist under Aniline Black.

Chlorate Discharges

Another interesting feature is that you can use the Indigosols as chlorate discharges. Gentlemen, that is also quite interesting. With the exception of red, it has not been possible to produce colored chlorate discharges on Indigo and gallo colors, because no other colors withstand chlorate. Indigosols stand chlorate very well. They are developed by chlorate. Therefore, if you take Indigo or any gallo colors and print on a chlorate discharge with an Indigosol, you get a color discharge on a ground, and from a theoretical standpoint I think it is a rather interesting fact that according to this method you can produce a vat color discharge on a vat ground, that is to say, on Indigo.

I should just like to say a few words about silk and rayon. Indigosols are very suitable for printing silk, not only unweighted silk but also weighted silk and there you also have a distinct advantage over vat colors. You can print vat colors very well on unweighted silk. There is no trouble about that, but when you come to weighted silk, there are very few vat colors which give good results. Indigosols print splendidly on weighted silk, but best of all according to the bichrome method by passing the goods through bichrome and sulphuric acid. In the short time at my disposal, I cannot go into details, but can give only general facts.

Now I should like to say a few words about rayon. Perhaps the Indigosols in Europe have interested the dyers and printers of rayon even more than calico printers and cotton dyers. You are all, no doubt, aware of the fact (you have the same difficulties probably) that it is not easy to dye rayon or goods with cotton warps and viscose filling level. That is not the fault of the dyestuff. It is the fault of the Viscose.

Indigosols dye cotton and Viscose level. The opinion is, therefore, that it is better to pad goods with a cotton warp and Viscose filling with Indigosols than to dye them in a jig with a direct color. First of all you have a bigger production, it is quicker work, and the goods are not handled so severely, and with Viscose it is very essential not to handle the goods severely. They stand a padding process much better than a couple of hours' dyeing. Indigosols padded on artificial silk can, of course, be resisted in exactly the same way as cotton goods are resisted.

I can show you a whole collection of very pretty goods which are done in Europe. All these light shades here are Indigosols and resisted with vat colors, the same vat colors you print on white goods. It is quite unnecessary even to raise the quantity of rongalite; the ordinary vat color printing pastes contain quite sufficient rongalite to resist the Indigosols.

Printing Celanese

Before I finish, gentlemen, I want to say a few words about Celanese, a product that has interested and is interesting all printers at the present moment. Indigosols can also be used to great advantage on Celanese, but you can't treat Celanese like you can cotton. There is a distinct difference between cotton and Celanese as regards the affinity of the Indigosols for these two fibers. You know that if you print or pad cotton with Indigosols, you can develop them in a short bath, and they are fixed. If you try to do that with Celanese, you won't get any penetration at all and you will get very poor results. But if you pad or dye or print Celanese with an Indigosol and then steam it for some time and then develop it in a rather hot acid bath, you will get a complete fixation. In steaming, the Indigosol penetrates the acetate rayon fiber and is fixed. And owing to this big difference, gentlemen, you can get some wonderful cross-dye effects on cotton and Celanese by using Indigosols. You can either dye those two fabrics the same shade, or you can leave the cotton white and dye the Celanese, or you can dye the Celanese and leave the cotton white, or you can dye the cotton one shade and the Celanese another with the Indigosols.

Let me explain to you briefly just what I mean. Suppose we have a fabric, cotton and Celanese. And suppose we want to leave the cotton white. Then we pad or print with an Indigosol, and steam for twenty minutes. The Indigosol is then fixed on the Celanese. Then we wash, and wash well, and wash the Indigosol away from the cotton. Then we develop in a hot bath and we have our Indigosol on the Celanese, and our cotton is white.

Suppose we want to do the opposite. We want to leave the Celanese white and dye the cotton. In that case we pad or print with the Indigosol and don't steam, but develop straightaway. The Indigosol is fixed on the cotton, but hasn't had time to fix on the Celanese, because we haven't steamed it, and the result is that we get the cotton dyed and the Celanese white.

Now we will go to the third case, which is quite interesting. We can get a two-tone effect using Indigosols. For example, let us produce a yellow on the cotton and a violet on the Celanese. That is a very pretty shop effect. We produce the yellow on the cotton in the following way: The cloth is treated with Indigosol Yellow and developed straightaway. The yellow goes on the cotton; it hasn't had time to fix on the Celanese. We again treat with Indigosol Violet, and steam. The Indigosol Violet has gone onto the Celanese. Then we wash the violet away from the cotton, but it remains fixed on the Celanese, and the result is we have a two-tone effect, yellow and violet, on cotton and Celanese.

Gentlemen, I don't know of any other group of colors that will do that trick.

I see, gentlemen, that my time is up. In the short time at my disposal, I hope that I have been able to give you some slight idea of the manifold purposes for which Indigosols can be used, so that when you go back you will think about it and get ideas as to certain styles or processes in which it might be well to use Indigosols to procure new effects. If I have been successful to-day in giving you some fresh ideas, I shall feel that my time has been well spent.

Thank you for the attention you have given me. (Applause.)

Discussion on Indigosols

President Killheffer—This has been a very interesting and a very able presentation. Although our time has expired, I have no doubt some of you would like to ask Mr. Cotton some questions. We will allow just four or five minutes for discussion of this interesting subject. Are there any questions or comments?

O. S. Forsdale—I should like to ask Mr. Cotton what he would consider the best way to produce a very bright green with Indigosols.

Mr. Cotton—We have at our disposal a very good Indigosol Green. If you wanted that green shaded, there are also yellows on the market. So you can really get any shade you want. I don't know whether you are acquainted with the green, but there is no doubt that if you apply to one of the color manufacturers who deals in Indigosols he will be very pleased to submit that green to you. I don't think it is right in

a conference of this kind to use any propaganda speeches. Therefore, I will simply say that if you want any detailed information about a certain shade or a certain color, the thing for you to do would be to apply to the two dyestuff manufacturers who are making it.

President Killheffer—Is there further discussion? If not, we will pass on. Thank you very much, Mr. Cotton.

The next paper is one by Arthur K. Johnson, of Cheney Bros., on "Cross-Sectioning of Textiles."

Cross-Sectioning of Textiles

By Arthur K. Johnson, S.B.
Cheney Bros. Research Laboratory

OWING to the deception of visual perspective experienced on looking vertically downward onto the top of objects, or to the inability of human vision to penetrate into the interior of opaque objects, and to the unreliability of purely mental "visualizations" of the conditions holding in the interior of natural objects when viewed only from the outside, there is often need for more than one point of view of the material being studied, in order to get an adequate conception of its internal structure or condition.

In most cases for microscopic study the object is shifted in its positions or is manipulated to satisfy this need.

In the cases of textile fibers, yarns and fabrics, all of which possess considerable length as compared to thickness, the common viewpoint is a plan view or longitudinal view parallel to the long axis of the object. By proper mounting, suitable lengths of these materials may be rotated about this long axis to render visible various aspects of the exterior surfaces. But in order to get a view of the interior, which view becomes increasingly important with the complexity of the object—the interior portions must be exposed and the exposed surfaces brought into favorable position for examination. This latter procedure is the province of *sectioning of textiles.*

To accomplish our purpose of exposing the interior surfaces, we must pass actual cutting planes through the material in definite directions with respect to both long and short axes of the object and in a sufficient number of places to render available all of the required information which is present in the object. After cutting, the cut faces are turned upward and then the internal condition may be observed at the point, or points, of cutting. This operation gives us sectional views of the object, which microscopically are on an even footing with the longitudinal view or plan view previously mentioned. Sectional views may be oblique to either one or to both axes of the object, but usually and most hopefully are "cross" sections perpendicular to the long axis and parallel to the short axis, or are "longitudinal" sections parallel to the long axis and perpendicular to the cross axis. (In fiber work the preparation of longitudinal sections would indeed be a hair-splitting procedure.) A single cut face may suffice or several faces cut in sequence and mounted and viewed in order of sequence may be needed. These grouped sections are called serial sections.

Much benefit could be obtained by the textile trade from a more common and more widely diversified application of sectioning and subsequent microscopical study of fibers, yarns and fabrics. In innumerable cases, however, where the urge to use sectional views has consciously or unconsciously been felt, this urge has not matured into a full-fledged activity. This may be because of a helpless realization of one's blank ignorance as to the proper method of procedure or to an intelligent recognition of the status that some methods are known but the art required to carry them out successfully is woefully missing. And the net result in either case may be a blissful dream of "what might have been" had they only known, followed by a turning of the back in psychological "fear" to the whole position.

It is the purpose of this paper to express the following convictions:

1. That the preparation of high-grade sections of fibers, yarns and fabrics which are thin enough to be transparent and yet be truly representative of the condition obtaining in the original object requires good apparatus and a high technical skill. One also might add a considerable length of time.

2. That in a large majority of cases such high-grade sections are not necessary for practical purposes and that accurate sectional views sufficient to the requirements may be readily prepared by simple and rapid means.

There are available, thus, two general groups of procedures for the preparation of sections. One group yields the high-grade, thin, transparent and exact sections suitable for viewing with transmitted light. These are obtained by slow and tedious processes requiring the high skill of an artisan to execute on expensive apparatus. The second group, somewhat makeshift at times, yields coarse, rough and ready, rapid sections which are more or less thick and opaque and which require reflected light for their observation. These methods employ little or no apparatus and require little particular skill in manipulation. I shall place emphasis on this second group.

General Principles to Be Applied in Obtaining Sections

The technique of sectioning textiles hinges upon a few general points or principles which are to be applied either to the preparation of the object for sectioning or to the actual cutting procedure or to the manipulation of the specimen after cutting for examination.

Principle No. 1: Keep a Low Moisture Content in the Specimen.—Air-dried or bone-dried samples usually behave the best when later brought into contact with chemicals for cutting. Excessive moisture gives poor binding contacts with these reagents and gives a troublesome blush or opaqueness to the sections. This results in sections of lowered quality and serviceability. The proper moisture content may be brought about by exposing samples to a dry atmosphere in a room, desiccator or moderately warm oven.

Principle No. 2: Convenient Coloring of the Material in Single or Varied Colors.—With certain limited methods for obtaining sectional views, the object must be pure white, dry and oil-free to obtain proper contrast in the section and to make illumination of the object easy. With most other methods, however, the use of properly colored objects is a decided advantage. It facilitates handling and arranging of the objects preparatory to sectioning, makes easy the location of the material in the section for mounting, and may properly aid during study in differentiating the various parts of the object. Coloring or staining may be done at different stages in the process depending upon the object being dealt with. It may be done before starting, during the operations before sectioning, after sectioning, or after mounting. Excessively dark shades in large proportions of the object are usually avoided. The employment of differential coloring, i. e., imparting different colors to different parts of the objects which have different chemical composition, is of great benefit in securing knowledge of the kinds of material present and their amount and location. This is illustrated by the example of union yarns or fabrics which may have been finished with pyroxalin solution or starch and may be composed of vegetable and animal fibers. The finishing material may be stained one color, the animal fibers second color, leaving the vegetable fibers white.

Principle No. 3: The Use of a Binding or Matrix Material to Prevent Any Change of the Position of the Parts of an Object During or After the Cutting of Sections.—In all methods involving preparation of thin slices of the object, it is very desirable to prevent scattering of the parts during or after the cutting. This is particularly important where an exact knowledge of the true relationship as to relative position of the parts is concerned—such, for example, as in complex soft fabrics or yarns. Furthermore, such binding treatment greatly facilitates the handling, locating and study of the objects all along the line of progress. Sections of bound objects behave as individual flat slices or "slabs" which can be mounted more easily and accurately flat side down and which show less tendency to tip over or break up in mounting or in observation, thereby spoiling the point of view.

Binding materials of proved worth are liquid materials capable of congealing or evaporating to a solid but not too hard condition. They should also be transparent, possess relatively little or no color and be more or less insoluble in reagents used later. Such binding materials may be collodion in alcohol-ether solution, dry cellulose acetate in dry acetone solution, 1-1 gelatine and glucose mixture in 1½ parts water.

In binding the objects with these materials, they are thoroughly impregnated with the solution of the binding agent and allowed to dry under more or less tension. A large part of the art in sectioning comes in recognizing the proper degree of hardness of these agents for cutting. If they are allowed to dry into too hard a condition they do not behave properly in cutting and if they are not dried hard enough, the sections twist and bend out of position. When properly dried, the material is firm and hard, yet is flexible and not brittle. It cuts with reasonable easiness with a safety razor blade. The proper degree of hardness to be attained must be determined by each individual operator for himself, and herein lies the first discouraging snag for the inexperienced man. The trial and error method coupled with sensible observation will soon overcome this trouble.

Principle No. 4: Provide a Mechanical Support Which Will Hold the Bound Object Rigidly on a Plane Perpendicular to the Plane of the Cutting Blade.—When using a rough method to give sectional appearances on tightly woven, felted or coated fabrics or on those having a hard finish, it is usually not necessary to give any preliminary treatment before cutting because the binding power of the weave or of the conditions of the fabric are sufficient to hold the slices together. At times impregnating the fabric with collodion serves admirably and sufficiently to make direct cutting of sections feasible.

For yarns and fibers or for fiber study in some fabrics the material may be held by a mechanical outside support such as split pith, split cork or a wooden or metal tube, any of which may be used to hold the fibers so that they may be cut across their long axis and the cut ends turned upward for examination. Some

of these holders are used in conjunction with gelatine or gum arabic.

The best results are usually obtained by imbedding methods, that is to say, the bound object is carefully secured by a solid block of paraffin or celloidin (or gelatine). In using these materials, care must be taken that no void spaces in the immediate vicinity of the object are present. This again requires a little skill.

Principle No. 5: Proper Conditions at Time of Cutting Must Be Maintained.—After the object has been properly prepared for sectioning by binding and imbedding, the next step is to cut the section. This may be done either by hand methods or in mechanical machines known as microtomes. In either case, properly equalized temperatures must be maintained between the imbedded object and the cutting blade, the position of the blade with respect to the object must be accurately maintained, the edge of the cutting blade must always be very keen, and the cutting stroke should have a draw stroke effect. Safety razor blades make very satisfactory cutting edges and may be used with proper attachments in either hand methods or in the microtomes. The successful carrying out of the cutting operation requires *more* or less practice.

Principle No. 6: Handling and Mounting the Sections.—The handling of the sections is usually a simple matter—a moistened brush, a metallic section lifter or a needle usually being satisfactory. In many cases the satisfactory examination of the object depends upon the success of mounting. This is particularly related to the difficulty of getting the cut face of the section accurately in view. A very handy method for mounting the larger sections (or even short lengths of yarns) is the needle method. In this method a small cork stopper may be cemented to a glass slide and a large needle inserted through the stopper parallel to the surface of the slide and about ¼ inch above it. The thread end of the needle may also be inserted into a second small stopper which serves for a handle. The stiff, cut section of cloth is then fastened by one end to the point of the needle, using collodion or Canada balsam, in such manner that the cut face of the section is parallel with the surface of the slide. When so mounted, it is an easy matter to rotate the needle, and therefore the specimen, so that the surface position is accurately and easily adjusted.

The second method of mounting is the common method which simply involves placing the section on edge on the slide either with or without cementing material. It is the method, of course, which must be used with very small sections. If the paraffin imbedding material is to be removed from the section before examination, this slide may be coated with a water solution of egg albumen onto which the section is placed. This slide is then gently warmed to melt the paraffin and the section allowed to settle into contact with the water layer. When this is done, the temperature is raised slightly to coagulate the albumen, and by this coagulation process the section is cemented to the slide. The paraffin may then be removed by immersing in a solution of xylol.

Actual Methods

Method No. 1: The Use of a Conically Bored Metal Tube.—For the examination of white, dry, oil-free vegetable fibers and especially rayons a very rapid and simple method of obtaining cross-sectional appearances involves the use of a conically bored metal tube. This tube may conveniently be about ¾ to 1 inch in circular diameter, about ¾ inch thick, having a flat top perforated in the center with a hole ⅛ inch in diameter. This hole has a square shoulder with respect to the surface of the block. As the hole proceeds down through the block, it rapidly expands in conical fashion to become perhaps ½ inch in diameter at the base of the block. These blocks may easily be turned out by any machine shop. With an ample supply of safety razor blades such as the Gem safety razor type, these blocks are all the equipment that is necessary for making the sections.

To prepare the fibers for sectioning they are arranged in more or less parallel fashion, then made into a conical wad (with a leading end) of such size that the base of the wad is too large to pass through the hole in the block. When the wad has been prepared, the leading end is inserted through the hole in the bottom of the block through to the top surface, the wad is then pulled very tightly into the block so that a firm core of fiber is obtained at the top nip of the block. Success in this method depends upon the tightness of the core of fibers at the top nip. To make the section, the block is held in one hand in such manner that the fingers do not extend above the top of the block, and a safety razor blade held at a slight angle to the surface of the block is passed with a draw stroke effect through the score of fibres in dragging contact with the surface of the metal. The surplus ends of the fibers protruding from the base of the block are then cut off with a pair of scissors and the block mounted on the stage of a microscope for examination.

The cut section is then exposed to the optical parts of the microscope in a satisfactory position. With proper lighting facilities, such as good daylight from a window or from artificial light such as the Silverman

Illuminator, this section may be studied with objectives up to an 8-mm. size, with satisfactory results. The particular satisfaction of this method is its extreme rapidity and the fact that the fibers are in no way physically or chemically altered.

Method No. 2: Gelatine Method for Yarns.—Rapid and satisfactory sections of yarns and fibers may be made by securing the yarn onto a spring wire to give tension, then dipping it into a melted solution of gelatine and glucose. When the air has been expelled from the yarn, it is withdrawn from the solution and hung up to dry in the air. When properly dried by evaporation, the bound yarn is placed between two pieces of a cork stopper, the cork stopper bound tightly together with string and then a safety razor is passed through the stopper and the fiber in such a direction as to give a cross-section. The section after being cut is carefully placed onto a glass slide, mounted in dilute alcohol or dilute formaldehyde, covered with a cover glass and examined. With a little practice, loose sections suitable for common study may be prepared by this method.

Method No. 3: Rapid Paraffin Embedded Method (Prof. Schwarz, M.I.T., Textile Lab.).—Fibers and yarns may also be prepared for sectioning in a rapid manner by a procedure advocated by Professor Schwarz. In this method, the materials are bound under tension with a reagent like collodion and dried in a warm place. The bound specimen is then rapidly embedded in paraffin (kept at 1° or 2° F. above its melting point) by soaking it for a few seconds in the melted wax to displace the air and to thoroughly penetrate the pores and spaces with the wax, then it is withdrawn from the wax and plunged into ice water for a few seconds to harden the wax. Upon removal from the water the specimen is shaken to remove surplus water drops, then lowered into the wax for a second, withdrawn, and chilled in the ice water. These alternate steps are repeated until a bundle of wax about a quarter of an inch thick has been built up around the fibers. Some of the surplus wax may be trimmed from the outsides of the block and the embedded specimen cut into short lengths (½ to ¼ inch) and squarely mounted onto the end of a wooden or other holder about a foot long, by gently warming the wax on the end of the specimen to soften it, then pressing the block firmly onto the end of the stick, and chilling the joined ends in the cold water. From this block-stick, properly supported by the groin and the left hand, numerous sections may be cut from the waxed specimen by a safety razor skilfully operated in the right hand.

The cut sections may be floated from the razor blade in a dish of cold water, carried from there and oriented onto an albumin coated slide, by means of a wet camel's-hair brush, gently warmed to soften and straighten the wax film, stained with alcoholic solutions of dyes, rinsed with water, then examined in air or mounted in water under a cover glass.

The trick with this method is to be able to cut the sections squarely across, and thin enough to be reasonably transparent.

Method No. 4: Paraffin Block Embedding for Use in the Microtome.—Where the cutting of the sections of fibers, yarns, or fabrics is to be done in a mechanical microtome, the preparation of the specimen is but slightly different from the method just described.

The material is carefully bound under tension with collodion or cellulose acetate in the absence of moisture, or with a small quantity of higher boiling solvent in the binding solution to prevent blushing of the binder. The bound sample must be dried to the proper hardness in dry air, then immersed in a solution of paraffin wax in a solvent like xylol to become thoroughly impregnated with the solution and until the air has been displaced. The material is now immersed in barely melted paraffin from which it is later removed and secured in a known position in a paper box in such manner that when the box is filled with melted paraffin wax, the fiber will be in the center, like the wick of a candle.

With the material in place in the box, the paraffin wax is poured in to completely fill the container. The box is placed in ice water and the wax allowed to cool as rapidly as possible from the bottom upward and from the outside inward. The box space is kept filled by frequent additions of melted paraffin, and the center is kept fluid until the last by means of a warm iron rod, until a uniform block of solid paraffin (no voids about the fibers) has been obtained well above the textile mount. The whole mass is then chilled thoroughly, the box cut away, the size of the paraffin block trimmed down squarely to proper dimensions to fit onto the specimen holder of the microtome.

President Killheffer—The next paper is entitled "Shrinkage of Cotton Cloth." I think a good many of you will find that of a great deal of interest. H. D. Clayton, of Cluett, Peabody, will present it. (Applause.)

The Shrinkage of Cotton Cloth

By H. D. Clayton
Cluett, Peabody & Co.

THE subject of "Shrinkage of Cotton Cloth" has always been an important one for manufacturers of wearing apparel, such as the manufacturers of underwear, shirts and collars. In using the term "shrink-

age" we are using the commonly accepted definition, that is, an apparent loss in dimension either lengthwise or widthwise.

Considerable study has been given this problem, particularly by shirt and collar manufacturers, but apparently very little consideration has been paid to it by mills or textile finishing plants. It has been the practice of manufacturers to accept materials finished as supplied to them and to make an allowance for shrinkage, such allowance being determined by an ordinary washing test to which the garments made from such fabric would naturally be subjected. After this wash shrinkage had been determined the patterns were made, oversize, so that when the garment was washed for the first time in a laundry or at home it would shrink to approximately the correct size.

The common practice of the finishing plant of finishing cloth with a gain of 3% or more had made it necessary for the manufacturer to make a larger allowance than he would have done if there had been no gain in yardage.

In the manufacture of collars, both starched and soft, the amount of shrinkage of the cloths used is determined by washing tests and the proper allowance for shrinkage made. Originally it was the practice to make up collars of three or more plies of different materials, using on the front of the collar a long cloth, counting approximately 96 by 100 and approximating 4.5 yards to the pound finished; with a heavy interlining of coarse construction, 3.75 yards to the pound, more or less, with a back cloth approximately the same as the front and counting 80 square or 72 by 76.

These cloths, as finished, would all shrink differently in a washing test and it was, therefore, necessary to give the fabric a preliminary shrinkage to bring the cloth down to a more or less uniform basis.

To illustrate: The 96 by 100 when washed in a regular collar wash would shrink approximately 2 to 2½ inches to the yard. The 375 interlining material might shrink as much as 2¾ to 3 inches to the yard. The 80-80 or 72-76 cloth, used for the back, would shrink from 2 inches to 2¾ inches, or more per yard.

Variations in Shrinkage

It was found that cloths of the same construction, bleached and finished in different mills, would not necessarily have the same shrinkage coefficient and therefore it was difficult to make proper allowance for shrinkage so that when a collar had been laundered it would be free from welts and wrinkles and would maintain the shape to which it was originally designed. The difficulties led to the adoption of a shrinking method which is used by most collar manufacturers.

The method consists in taking the cloth as finished by the finishing plant and soaking it in water and then drying by any of the ordinary drying methods. Some manufacturers have resorted to the centrifugal extractor to extract the major portion of water from the cloth so that the amount of water to be evaporated by steam drying would be cut down to a minimum. Others have used hydraulic presses for pressing out the excess of water and still others have used the easiest and most common method of simply lifting the cloth from the soaking tub and without attempting to remove any of the moisture, drying it in a loop drier or over dry cans.

A great many experiments have been tried to find out the best conditions of temperature, length of time, etc., to obtain uniform results and from the results of these experiments it has been quite definitely determined that the essential thing is to see that the cloth is thoroughly impregnated with the water and that all of the air in and between the fibers and threads has been displaced.

The length of time of soaking, in order to accomplish this result, varies with the kind of material used and especially with the manner in which the cloth has been dressed and finished. The time of soaking can be shortened by the use of hot water but in the case of cloth which is more or less heavily sized, hot water is objectionable for the reason that it is more apt to disturb the physical condition of the sizing and remove a considerable portion of it. For certain types of manufacture it is highly desirable that stiff or moderately stiff cloth be used. In the collar industry, for instance, cloth which has an appreciable amount of sizing can be handled on the sewing machines with less chance of wrinkling and with less opportunity for distortion of shape.

Uniform Shrinkage

This shrinking method which I have just described, namely, soaking of cloth in water without agitation, does not produce a complete shrinkage but it does have a tendency to reduce the shrinking of cloth of different construction so that when they are sewed together and are laundered in their final manufactured product a more uniform shrinkage takes place in the various plies and an article such as a collar can be manufactured with less difficulty and with much more perfection as to detail.

From the standpoint of the shirt salesmen and the shirt buyers it has always seemed advisable to maintain the original finish which has been put onto the

cloth by the finishing plant. Retail salesmen, shirt purchasers (shirt wearers) insist that when they purchase a new shirt they value very highly the fine lustrous appearance of the new article, even though in subsequent relaundering and wearings the original luster is more or less entirely removed.

It is claimed by people who sell such merchandise that a customer is willing to wear a garment which is much too large for him when new in order that his vanity may be appeased by the fine appearance of the new article for a few days' wear, even though that fine appearance is sacrificed for 95% of the life of the garment.

Unshrinkable Fabric Rare

At the present time, however, there appears to be an insistent demand by the buying public for articles which do not shrink. I have no doubt that this feeling has been, if not promoted, aided by our friends in the laundry industry and by the fact that about 80% of all shirts manufactured to-day have collars attached, and a consideration is being given to the subject of producing fabrics which will have all of the sheen and luster to which the shirt wearer has been accustomed and also the added feature of non-shrinkability.

I believe that the average shirt wearer, in thinking of shrinkage, particularly to-day, thinks of the collar and the sleeve length.

As practically all shirts and collars are cut with the lengths of the garments running parallel to the warp, it is lengthwise shrinkage with which we are primarily concerned. In fact, the ordinary piece of finished cotton fabric used in shirts and collars shrinks very little filling-wise.

It is not my purpose to-day to go into a technical discussion of why woven cotton cloth shrinks. A great many of the reasons are apparent to all textile men. I do wish to point out, however, that it is a very difficult proposition to produce a non-shrinkable cotton fabric which can be manufactured into articles of wearing apparel with a guarantee that the article so manufactured will not shrink when subjected to the customary methods used in laundries.

There is such a wide variation in laundry methods which are in use that it is easily possible to have a difference of as much as 1½ inches to the yard in measurement. Take a collar-attached shirt, for instance. We will assume that it has been washed by the standard formula of the L. N. A. in a standard type wash wheel and it is about to be ironed. If the collar is ironed by hand and is appreciably damp, it is possible for the hand ironer to stretch the collar from one-half to three-quarters of an inch. If the collar is ironed on a press, it is very apt to come back to the wearer without any stretching and with a multitude of little, fine wrinkles pressed into the band, which may not be noticeable to the casual observer, but nevertheless have a material tendency in shortening the collar and giving an abnormal shrinkage result.

The adoption of a standard method for testing such shrinkage is, of course, absolutely essential. The adoption of such a standard method in practice is much more difficult.

A survey of the laundry industry made by one of the large laundry machinery houses several years ago disclosed the fact that fully 80% of the washing of the United States is done at home. These figures may not be correct for the present day, but I would venture to say that they are not very far off. Practically all of the ironing done in the home is done with a hand iron.

In the power laundries, both hand and machine methods of ironing are used. If a machine method is adopted as a standard it will undoubtedly give results which will be at variance with hand methods.

I have presented these few thoughts on the subject to you and I hope that they may provoke some discussion. It is a question which has been given very little consideration by mill men and finishing plants but is a question which must be reckoned with and must be solved if the public continue to demand it.

President Killheffer—Is there any discussion on this paper, or are there any questions to be raised in connection with it? If not, we will proceed to the next paper, "Problems in Dyeing Sulphur Blues," by Walter F. Haskell. If I am informed correctly, I should introduce the speaker as Mayor Haskell. Isn't that correct? (Laughter.)

Problems in Dyeing Sulphur Blues

By Walter F. Haskell

IN attempting to address this meeting of the Association I find myself in the state of mind which I think many other dyers will share with me. When I try to talk shop I at once discover that I have no complete solution to offer of the problems which I intend to discuss, only some slight clues which have never been followed up very far. So I am not attempting to say anything very definite or final about Sulphur Blues, but only giving some of my opinions.

It so happens that my first efforts in dyeing were practically contemporaneous with the general introduction of the Sulphur Blues into the dyehouses of this country. I remember with what great satisfaction we found that we could dye Sulphur Blue instead

of Developed Blue at no greater cost, without having the nitrous acid fumes around, which were rather troublesome.

We had been dyeing Sulphur Black long enough to have built up some reserve experience and had found that to avoid streakiness the warps had to run from the dye bath to squeeze rolls directly into a washing tank. To dye this blue, then, we took our rectangular wooden dyeing machines, which we were using in those days, and set two of them together, one in front of the other, so that they were driven at the same speed. The dye was in the first tank, the warp passing through squeeze rolls out of this tank into the second tank, full of running cold water. Four or six passages through this machine are usually sufficient to give the required depth of shade. The dyes were very satisfactory and I have never been able to improve very much on that method. To-day our tanks are iron. The dye tanks are relatively larger, and the rinsing tank smaller, and sometimes two are used, one with warm water and one with cold, but the essentials of the machine have not changed. Sometimes a skying roll is used between the squeeze rolls out of the dye and the first rinse. This gives a little time for the dyed shade to become somewhat oxidized by the air before it reaches the rinse water and probably less color is washed off.

Perhaps there is something of a personal equation involved here, as I belong with those dyers who were brought up on the so-called Scotch system as practised formerly in our New England gingham mills. I find myself loathe to give up the flexibility of the double warp system for methods involving the continuous dyeing of warps in their full length. Perhaps such methods may be free from some of the difficulties I have met, but from what I have heard I believe they involve some troubles of their own. .

True Shade Blues Scarce

Our 1927 Year Book lists 47 American-made Sulphur Blues by twelve different makers; 21 of these are divided in varying numbers among four pre-war prototypes. These, with the greater number for which no corresponding pre-war types are given, apparently ought to give the cotton dyer almost any kind of blue that he can wish for, except that the brightness of the vat blues is never quite attained. A sample book showing all of these 47 blues would appear to be a large collection of blue dyestuffs of good quality and low price.

But unfortunately it seems to be rather difficult with many of these blues to produce on warp their true shade and value. Those of the brighter and more greenish tone which are reduced in dyeing to a yellow or nearly colorless dye bath are apt to be disappointed. They are likely to come out reddish and dull, falling considerably short of the brightness and depth of laboratory dyeings, and they frequently resist very persistently all attempts to improve their tone by oxidizing and brightening agents.

The so-called direct dyeing blues, which are not reduced very much, if at all, show the same tendency in light shades to be red and dull, but in fuller shades come out better and are more satisfactory to dye. Very heavy shades are sometimes green and dull and also very hard to break. All this refers to chain dyeing.

Dyeing Beam and Package

For beam and package dyeing Sulphur Blues have the necessary good solubility and work pretty well, as far as getting the dye on the fabric is concerned, except that samples will show something lacking in brightness. The great problem has been to extract and wash them without spoiling the color. If the beams are blown with the compressed air before they are washed they are apt to show all possible degrees of bronziness. If they are washed before extracting, a large part of the color washes off, leaving a thin, dull and greenish remnant behind. As a general statement it may be said, subject of course to exception, that the more the color reduces in the dye bath, the worse these troubles are, and the more nearly the dyestuff used resembles a good Sulphur Black in its dyeing properties, the nearer the final shade will be to a laboratory dyed sample. As far as my experience goes, a good direct dyeing Sulphur Blue can be dyed very satisfactorily in the Brandwood beam dyeing machine, if one is willing to sacrifice a little brightness; 6% of Pyrogene Direct Blue, for instance, with about 1% of Sulphur Black of 100% strength added, chain dyed is practically the same shade as an equivalent per cent of the blue alone beam dyed. I have been informed that in cotton piece dyeing many of these chain difficulties occur. There are only a few of the so-called direct dyeing blues that can be successfully dyed on the jig. All the others are apt to have dark selvedges, and to show decided tendency toward general cloudiness.

I am also informed that most Sulphur Blues can be dyed on piece by the continuous process but that there is difficulty in matching for the start and also in securing uniformity on a run of any great length. This is also true with continuous dyeing of warps. The shade is usually redder at the finish than at the start.

I have been told that the experience of skein dyers with Sulphur Blues have been rather satisfactory and

that good dyeing can usually be obtained in an ordinary open tank or in some of the machines commonly used, such as the Hussong, for instance. In handling raw stock, as is ordinarily done, in machines of the closed type, the same facts apply, I am informed, as to other circulating machines, but if these various defects are found the subsequent treatment of cotton in carding and spinning renders them less apparent and of less importance.

Many of the Sulphur Blues are improved in brightness, or fastness, by the after-treatments commonly applied to sulphur colors, such as bichromate and acetic acid, perborate of soda, boiling soap, etc. As a rule their fastness toward subsequent manufacturing processes, such as cross-dyeing, crabbing and steaming, scouring and fulling, singeing, etc., is satisfactory.

I have but little definite information as to how well the ultimate consumer is pleased with these blues in his clothing, his automobile upholstery or his draperies, etc. It is significent, however, that vat blues are coming to be used more and more for these purposes. As shading colors in grays, taupes and slates, etc., they are very useful and much superior to small quantities of Sulphur Black in fastness to cross-dyeing and scouring.

In my own work for the last few years I have found some shades for which the Sulphur Blues have been well nigh indispensable, but their number has not been great nor the quantity of each very large. On that basis my conclusion is that the Sulphur Blues have an important place to fill, but not a very large one, but an estimate based on such narrow grounds is, of course, of little value. Our president, with his extensive knowledge of the dyestuff consumption in the United States, evidently believes that these blues are of sufficient importance to be discussed at this meeting, so I am hoping that my subject has given perhaps some value and interest to this incomplete and brief treatment of it.

[*The remaining papers delivered at the Saturday Afternoon Session will be published in the next issue.*]

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The lapel button badge illustrated herewith is worn by members of the American Association of Textile Chemists and Colorists.

The three "rings" are enameled in red, yellow and blue, respectively, and the initials and border are brought out in gold. The general effect is exceedingly attractive.

Badges may be secured at $1.50 each by addressing the Secretary.

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Published biweekly by
HOWES PUBLISHING CO., INC.
90 William Street, New York City

A. P. HOWES, *President* E. S. PREDMORE, *Secretary*

Subscription price $5.00 per year; Canadian $5.50; foreign $6.00

Vol. XVIII January 7, 1929 No. 1

CLOSING THE BOOKS

WITH the close of the holiday festivities last week this old world found itself facing a date on the calendar that denominated an End and, one square beyond, another date that denominated a Beginning. At such a time there should come a brief retrospection, a kind of mental balancing of the columns and a mental closing of the books for the past year 1928.

There is satisfaction rare and sweet in telling oneself that one's business has actually moved ahead in the swift, transitory procession of days designated on man's calendar as one year; that during this advancement it has achieved also a higher, more estimable reputation; that not only has the *name* of one's business deserved the priceless faith of one's customers, but also that the product and the service which this name represents have become more worthy of such faith, more useful in their particular sphere of industry than they were one year ago; that the noble-sounding Code of Ethics so elaborately lettered and framed there on the wall above one's desk has been kept in sight conscientiously as well as literally, in all the transactions of one's business during the past year; that, as a consequence, not only is there more honest silver in the till, but that one's latent wealth has also multiplied—one's wisdom or intellectual wealth; the broader, freer outlook on life; the character more tightly knit; the personal reputation more firmly established; the warmer feeling of good-will between one's associates and oneself; the deeper respect attained, the friendships more solidly cemented, and the deeper sense of obligation toward the industry of which one's business is an integral unit—this is all *wealth*, and it is extremely satisfying to retrospect on its multiplication during the past year.

It is mightily inspiring, we repeat, thus to retrospect not only upon the material progress of one's business and one's own interests, but on that more abstract and spiritual progress which each passing year's end ought to record upon the books of our conscience. But let us not fail to recognize that such retrospection and inspiration have fire in them and power. And it follows that this power and this fire should not be wasted nor burn in vain, but that it should be utilized as a precious personal incentive to strive toward continued progress, and to exceed the past year's advance in the year that has just begun.

THREE OPTIMISTIC VOICES

BECAUSE business dominates the life of this nation to-day we naturally look to our business leaders and authorities for that note of optimism which rings in every new year.

At one time many of us believed that the United States was dangerously wallowing in a mire of commercialism. The cartoonists in Europe drew your Uncle Sam as the calculating, cold and greedy "Shylock" sacrificing every national virtue on the heathen altar of the almighty dollar. Militant groups united here to fight the domination of big business in our rapidly changing social life. Have we no ideals? they cried.

But a saner, calmer view of our condition has revealed, to most of those who thus opposed the policies and doctrines of American business, that nothing can really be done about our national wealth. Our citizenry have set the pace for other nations in raising the standard of their living from one decade to another, and much more than our material comforts and luxuries are traceable directly to the stable foundation of our national business. For this reason, then, we as a nation turn at the new year's beginning for some word of what the future may hold to the business leaders of the country.

Here, then, are the opening words of a statement issued by C. E. Mitchell, president of the National City Bank:

> Business is entering the new year upon a high level of activity and with confidence in the continuance of prosperity. Judged both by the volume of business and resulting profits, 1928 apparently has surpassed the records of any preceding year.

In his statement on economic conditions and prospects for the coming year William F. Whiting, the new Secretary of Commerce, says:

> Wages continue at a high level and unemployment has been reduced to a minimum. There has been a continued demand for additional workers by mercantile establishments, hotels and the automotive industry, and factories have once more been increasing the number on their payrolls. Labor conflicts in the coal and cotton textile industries were settled during the past year, and relations in most sections of the labor world are now amicable.
>
> Activity in the automotive and construction industries has been sustained and is particularly notable. . . . Production of many related products, such as iron and steel, cement, gasoline and rubber tires, has been stimulated as a result of these developments. The textile and coal industries, however, still lag behind the others.
>
> Foreign as well as domestic demand for the prod-

ucts of our farms and factories is steadily expanding.

In general, it may be stated that both industry and trade are exceptionally active as we enter the new year.

Enlightening for its range of information and its keen analysis of current conditions in many fields of business was the "Domestic and Foreign Trade Outlook" issued last week by Dr. Julius Klein, Director of the Bureau of Foreign and Domestic Commerce. This enlarged upon Mr. Whiting's statement and would be worth printing in full if space permitted. This summary, however, should be given:

> We may state that domestic production and trade are in record volume and that our foreign commerce continues to show steady growth as a result of an increasing foreign demand for American manufactures. The maintenance of our imports at about the same level as in two preceding years indicates the large purchasing power and general prosperity of the United States.

DYE IMPORTS AND TARIFF REVISION

NO matter how drab and dull most trade statistics are to the average man in the street, they always hold an element of real interest to those affected by their rise and fall. The monthly figures for dye imports into the United States, for example, if watched carefully over a period of several months are almost sure to contain a surprise or two for the domestic dye industry. The sudden if temporary spurt in our consumption of foreign dyes as shown by the October and November import totals is not only interesting but rather puzzling. With the air around Washington smokey this week with arguments on tariff revision, import figures on all chemical products, in fact, become of absorbing interest to our manufacturers.

Actually, of course, there is not the slightest relation between any sudden rise in our dye imports for one month and the clamor for higher tariff schedules on chemicals The tariff will be revised by Congress, anyway, maybe in a special session, and it must be conceded that the present schedules on coal-tar products are far from being effective. The need for this tariff revision was fully realized by the industry many months ago and, wisely enough, preparations were made at that time for submitting the necessary evidence to Congress.

As this issue of the REPORTER goes to press the tariff hearings on chemical products have just opened before the Ways and Means Committee and nothing is yet known about the proposals made for revising the rates of dyestuffs. But more effective rates are certainly needed, regardless of the import totals for *any* month. After all, the annual figures on dye importations tell the true story and, studied in detail, they indicate plainly the weak spots in our present dye schedules.

One very interesting side issue revealed in recent monthly statistics on dye imports is the perennial conflict between Germany and Switzerland for a share of our trade. For the eleven months' period from January to November, 1927, Germany controlled over 57% of our foreign dye purchases, Switzerland trailing behind with about 26%. In the same period *last year,* Germany had gained and her sales of dyes to this country represented 65% of our imports, Switzerland's, 24%. In this case some of the smaller foreign dye-producing countries lost ground to Germany's advance. During the month of November, 1928, more than 72% of the foreign colors imported here came from Germany, while Switzerland's share of our trade had fallen to 21.6%.

Any tariff revision covering dyes that may be decided upon, however, will not discriminate between either country, and their rivalry will continue from month to month. For the revision will be made chiefly for the purpose of protecting certain extremely valuable types of colors being developed by our dye laboratories, colors that are important not alone because they are demanded by the textile industry, but also because their production and sale in quantities will help strengthen an industry that continues to be one of our most precious national assets.

RAW SILK CONFERENCE PLANNED

Technical Experts to Meet Next Spring

MAJOR silk producing countries of the world will be invited to meet in New York in the spring of 1929 for an international technical raw silk conference, which is being arranged by the Silk Association of America, Inc., according to an announcement made public following a recent meeting of the board of managers of the Silk Association of America, Inc.

Among the associations who will be invited to send technical experts to advise and confer with the Raw Silk Classification Committee of the Silk Association, are the raw silk associations of Japan, China, France, Switzerland and Italy.

Although several official visits to this country have been made by Japanese silk interests, the most recent being in 1923, no international gathering has been held before to confer on raw silk problems.

Other business transacted at the meeting, which was presided over by H. Schniewind, Jr., president, was the appointment of a committee to nominate candidates for the board of managers to be elected at the annual meeting of the board, which will take place March 27, 1929. This committee includes Irving Lewin, Lang & Lewin, Inc., W. L. Hirbelauer, Associated Dyeing & Printing Corp.; W. W. Metcalf, the Portland Silk Company; Paoline Gerli, E. Gerli & Co., Inc., and Adolph Muller, the National Ribbon Company.

COTTON AND RAYON SUPERIOR IN TRANSMITTING LIGHT

Bureau of Standards Studies Radiation of Ultra-Violet Rays by Cloth

MOST of the dyes in common use reduce the ultra-violet transparency of cloth, and white batiste or nainsook cotton, linen and rayon are more transparent to ultra-violet solar radiation than pure silk or wool. Such, in brief, are some of the findings of the Bureau of Standards at Washington resulting from a study undertaken by the radiometry and textile sections of the Bureau. The text of the summarized results of the tests follows:

It is well recognized that the short wavelength ultra-violet rays in sunlight exercise a strong effect in restoring the human body to health, and recently considerable attention has been given to this subject from the medical standpoint of sales promotion of special kinds of wearing apparel on the supposition that it is especially transparent to ultra-violet radiation.

In view of the numerous inquiries regarding the accuracy of such claims the Bureau of Standards undertook a quantitative determination of the amount of ultra-violet radiation transmitted by fabrics made from various kinds of thread; cotton, silk, wool linen and so-called artificial silk commonly called rayon, etc.

Measurements were made on close-weave and open-weave cloth. White and black samples of the same weave (e. g., satin, twill, voile) were examined; the black to determine the amount transmitted through the openings between the threads and the white material to determine the amount transmitted through the threads.

The results of the research demonstrate very clearly the importance of using bleached white material in order to obtain a high transmission of ultra-violet rays through the thread. A slight yellowing of the natural silk, or the yellow color of unbleached cotton greatly reduces the transparency of the ultra-violet. Likewise most of the dyes in common use reduce the ultra-violet transparency. Hence, as is to be expected, comparing dyed fabrics, the one having an open weave transmits the most ultra-violet, irrespective of the composition of the thread. It is found that white cotton and viscose rayon, which substances are practically pure cellulose, also linen and cellulose acetate rayon, are the most transparent to ultra-violet rays. Natural silk, that is not yellowed with age, stands a close second in the order of transparency to ultra-violet rays. Woolen fabrics are only about one-half as transparent to ultra-violet solar rays as white cotton.

Edward L. Hinchey, former treasurer of the Stafford Mills, Fall River, Mass., has accepted a position with the sales force of the Taber Mill, Inc., New Bedford, Mass.

HOW INDIAN TEXTILES ARE TIED AND DYED

THE beautiful "tied and dyed" textiles originating in India have also been found in other countries. The Japanese color silk fabrics in the same laborious and complicated manner, but use only small cloths and wear the finished article as bright ornaments in the hair. The same type of textile has been found in a small mountain town on the Island of Cyprus where the women still make the fabrics for scarfs—for their own use, not for commercial gain—though the custom is dying out.

The women of northern India have made the coloring of these fabrics a thriving industry. They start the process with a piece of cotton or silk of one color, pulling out small folds and tying each fold with a thread or fine string. When a number of folds have been tied up following a certain design the whole piece is dipped in a dye of a second color. The part covered by the string retains its original color, forming a circle or dot. Then more folds are tied and a third color is used. By continuing this process the most intricate designs are made and the result is an elaborately figured textile.

Such fabrics, because of their lightness and delicacy, are sometimes called "running water," due to the fact that they can hardly be seen when placed in a stream, or "floating air," being so light and transparent when tossed in the wind.—New York Times Magazine.

CAROLINA COLLEGE TEXTILE SCHOOL REPORTS ON TESTING WORK

An interesting report was recently issued by the Textile School of North Carolina State College outlining the testing and technical research work carried on for Southern mills since January, 1927. According to this report no less than thirty separate assignments in research had been completed; some of these were given as follows. A number of them relate to dyeing and dyestuffs: Comparison of strength and quality of different samples of knit goods, yarns made by yarn mill and made into men's knitted underwear. Comparison of dye on yarn. Analysis of imported sheeting. Analysis of indigo paste to find per cent of Indigotine. Allowable percentage variation in indigo paste. Chalk marks on cotton, to determine whether or not these can be removed in bleaching.

Test of alcohol dye solution to determine volume of alcohol in solution. Test to determine presence of injurious ingredients in slasher preparations on yarn. Viscosity test on starch. Test to determine variation in counts of yarn. To determine class of dye in hosiery. Breaking strength of chambray used for men's shirts.

To determine reason for formation of scum in dyeing liquor. Testing gingham fabrics for break-

ing strength. To determine removability of chalk stains on cotton skeins previously treated with and without spray method of preparation. To ascertain breaking strength, size, evenness, and elasticity of nine samples of yarn.

To determine cause of cloudiness in black dyed cloth. To obtain construction, breaking strength and elasticity on cloth used for special purpose. To try to remove black marks by practical mill method and determine cause of streaks in knit goods made from yarn submitted. To determine presence of cotton in linen goods.

DYE FASTNESS RESEARCH IN ENGLAND PROGRESSES

During the summer of 1928 the Society of Dyers and Colourists of Bradford, England, instituted a series of exposure tests for the purpose of testing the fastness of dyed fabrics to perspiration, according to a report recently issued by the Department of Commerce based on information from Consul A. R. Thomson of Bradford.

Professor McSwiney, of the Medical Department of the University of Leeds, has undertaken to supervise this research work, and the British Research Association for the Woolen and Worsted Industries has provided, under a joint arrangement with the Society of Dyers and Colourists, a salary for the research worker in order to obtain definite information on the constitution of perspiration before anything is done to prescribe tests for fastness. Consul Thomson includes in his report an outline of the project as well as what has so far been accomplished in the investigation.

SPAIN REGULATES DYE IMPORTS

Bringing foreign dyes into Spain is a rather complicated process when importations compete with domestic products. Among the provisions of a royal order recently issued relative to coloring products which shall be considered as of national manufacture are the following:

"1. There shall be considered as products of national manufacture all of those included in the list accompanying this royal order, said list to be subject to changes as circumstances may require.

"2. Authorization is granted for the importation of samples, containing coloring products each weighing up to 250 grams, provided the necessary permission for importation has been requested and granted and the corresponding duties paid, said importation not requiring the presentation of samples to the Junta.

"3. In order to avoid any abuse in importation rights it is required that as soon as the manufacture of a new coloring product is reported by the Junta to the Central Commission, said product shall be added to the list and the inclusion mentioned in the Gaceta, the permission granted for the importation of said products expiring on the date of inclusion in the list of national manufactures, exception being made for those shipments which can prove their departure from point of origin to have been previous to the publication of the aforementioned inclusion in the Gaceta."

CHEMISTS AS WRITERS

Speaking before the Manchester Section of the Society of Chemical Industry recently, Dr. W. Hubball dealt with the subject of "The Chemist and His Message." The chemist had been described, said Dr. Hubball, as "the only man in the world who has something to say and the only man who does not know how to say it." Considering the main records of his writings, the position was not a good one. His reports were necessarily mere statements of facts, but even the additional scope offered by a thesis often resulted in efforts none too good. As for the technical journals, it would be admitted that their average literary standard was not a high one, and the same remarks applied to scientific and technical books. In fact, in many of the latter at present being published even the technical subject-matter was of a poor quality. Thus, while technologists were many, writers of quality on technical and scientific subjects were few. However, there were reasons for such a position. The world of the technologist was essentially a world of doing; he was always dealing with materials, and his talking must almost always be based on the actual results of this work. These were imposed conditions which might conceivably be detrimental to the free exercise of the imagination in writing.

The chemist must work until the achievements of his fellow scientists and himself were recognized in the press and elsewhere as they should be. To do this, he must undoubtedly himself take a greater interest in literature and the art of writing.—*Chemical Age.*

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